E LIBRARY

JAN 2 1924

McGraw-Hill Company, Inc. December 29, 1923 Twenty-five Cents Per Copy

ENGINEERING & MINING JOURNAL-PRESS

A CONSOLIDATION OF ENGINEERING AND MINING JOURNAL AND MINING AND SCIENTIFIC PRESS

Selective Flotation at the Magistral-Ameca Plant

Using a new combination of oils to separate copper and iron sulphides

By Dr. Henry Mace Payne

Trade Statistics and the Non-ferrous Metals

By F. E. Wormser and E. H. Robie

The Chino Enterprise—IV

By T. A. Rickard

Measuring Depth of Rotary Drill Holes

By A. G. Wolf

Beginning the New Year

A prospector in The Pas district, Manitoba

This New S-A Feeder Converges Two Streams of Material

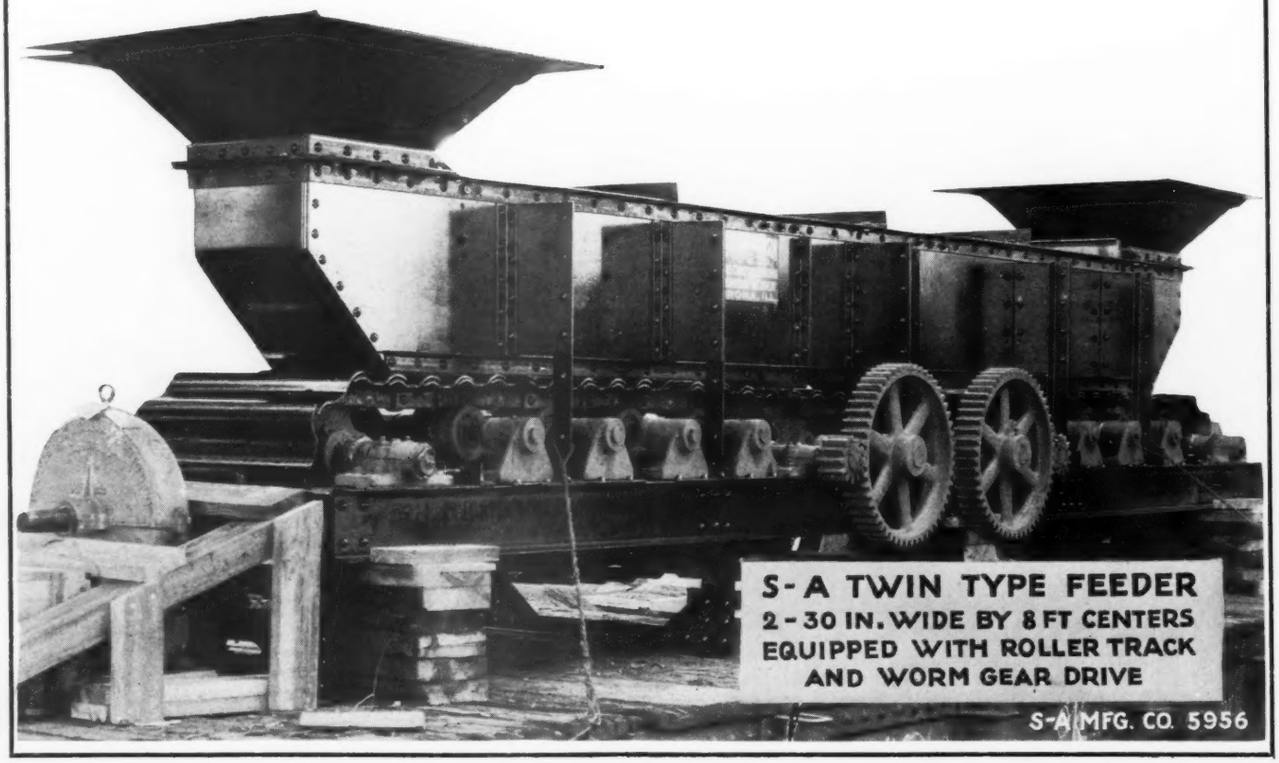
Here is a twin-type feeder which provides a wide range of service in the converging of streams of material. Its receiving hoppers deliver directly onto conveyors which both move to the center and deliver into a hopper or onto a conveyor or storage pile.

Wherever there is existing or contemplated use of duplicate equipments operating side by side, this type of S-A feeder is not only desirable but economical.

These feeders can be supplied in any desired size. The one shown in the photograph reproduced below was built for the Tennessee Copper Company. It is fitted with two 30 in. wide by 8 ft. centers conveyors which operate on S-A Roller Type track and are driven by worm gears. The structural steel frame, feed hoppers and skirt boards are standard with this type of feeder.

Price quotations will be sent upon receipt of an inquiry including distance between streams, nature and size of material, capacity and other definite specifications.

STEPHENS-ADAMSON MFG. CO.
Aurora, Illinois



ENGINEERING & MINING
JOURNAL-PRESS
JOSIAH EDWARD SPURR, Editor

Volume 116 | New York, December 29, 1923 | *Number* 26

The Prospector and the Land Office

RECENTLY our curiosity led us to attend a hearing held at one of the government land offices in the West. This hearing was conducted with all of the trappings usually found in the ordinary law court minus some of the usual accessories. The case in question involved a conflict between a group of mining claims and a "grazing homestead" application. The mining claims have been in undisputed possession of the prospector for a number of years. The "grazing homestead" was filed upon on Sept. 1, 1921. From what we can learn the land is of little value for grazing purposes. For a number of years the prospector has dug around in tunnels and open cuts in an endeavor to unravel the mysteries of the area and in the search for an oreshoot. A townsite and millsite were filed upon by the prospector and he has also been in undisputed possession of these areas. We understand that he has lived consistently upon the ground and with his meager resources has endeavored to make a mine out of the mineral area. He is, in our judgment, a worthy citizen and entitled to his rights and privileges under the mineral laws.

Apparently the resources of the local land office are being directed to discredit the prospector and to sustain the rights of the later claimant. The testimony of the government witness, whom we heard, clearly indicated that the region was one in which mineral might be expected to occur. There were sufficient mineral indications to interest the experienced prospector. He had followed these in his workings, but had not developed a commercial deposit. The government witness had visited the property in question, and had applied orthodox sampling methods and had obtained low assays—lower, as he stated, than the content of the copper ore now being worked by the Utah Copper Co. The said expert stated that he knew he had not been salted, as the precious samples to decide the government's strange case had never left his possession until delivered to the assayer. Although the witness stated that he did not want to insinuate that another witness's samples had been tampered with, he gave elaborate testimony to show how this could have been done. He aired his familiarity with the ways of engineers, but showed conclusively that he knew nothing about prospects. No engineer expects to find a developed orebody exposed in a prospect. A prospect, as it usually exists, is an invitation to someone to dig a little further into the ground than nature has dug. Without this effort few mines would be found. In this instance the prospector was on his way. The government witness found no orebody and offered adverse testimony.

We are of the opinion that the Land Office has seriously overstepped its proper function in this instance, and by its actions is raising the question as to its fair treatment of mineral claimants. Why should it seek to discredit this old prospector? Why should it cause him to employ a lawyer and summon witnesses to protect his ground? Sympathetic co-operation between the Land Office and prospectors is to be expected, and not the operation of a ruthless machine that works by formula and wipes out a going prospect simply because a commercial ore deposit is not exposed. If this case is allowed to go through, what are we to expect of the thousands of similar prospects?

Mining Under the Sea

"THERE IS A GREAT DEAL of water on this earth of ours, and a great deal of land underneath it," says one of Hearst's New York papers editorially. Think of it! From what depths of thought wisdom is brought forth to be broadcast to the multitude! Is it a wonder that as a people we are so enlightened? "All the treasures of these hidden plains are simply put away for our future use by bountiful nature," continues the writer, "as prudent parents put money in the savings bank for their young ones."

In Chile they mine coal under the Pacific; in "Wales" the tin mines extend beneath the sea; Calumet & Hecla is working beneath Lake Superior, and in California oil wells driven beyond the shore line are yielding their production—all these little enterprises, the writer says, are "but faint beginnings of the great work that man has to do in exploiting the wealth beneath the waters covering two-thirds of the earth's surface." "This earth will be quite a romantic abode when suboceanic exploitation reaches full development," he continues, "when the great gold mines beneath the waters are indicated simply by latitude and longitude."

We stand dumfounded. The finite mind cannot comprehend the infinite, even when it be infinite optimism. But what mine pumps there will be!

Visual Examination of Crushing Action

THE LIGHT THROWN on the subject of crushing ore in ball and tube mills by the researches of H. E. T. Haultain and J. C. Dyer, of Toronto University, by motion-picture observation of an experimental mill in operation, has stimulated thought and discussion. The pictures, recently exhibited at Columbia University, show the sliding action of ball on ball, to an extent that confirms the opinion held by many metallurgists and millmen that impact played a secondary rôle in achieving the result. This conclusion was reached ten years ago by the writer of these notes, who then made a comparative test using grinding media of widely different surficial characteristics. In one mill a smooth-surface, hard pebble was used; in another, a comparatively rough-surface trap rock. In spite of uniformity in other conditions, it was found that the rough-surface pebble gave by far the best results and it was realized that the reduction in slippage and the increase of grip between pebble and pebble had much to do with the increased efficiency.

The factor of surface characteristic is one that influences other types of grinding machines as well. A reduction in output from a grinding pan is evident when a high-grade steel is substituted for white iron as the raw material used in the manufacture of shoes and dies. The economy resulting from decreased abrasion when steel is used is more than counterbalanced by the reduction in output in consequence of slippage rather than grip.

However, as in all other points that are in dispute, a clear conception of what occurs in a cylindrical mill demands a broad interpretation of results and an appreciation of the variability of controlling factors. Of these, the speed of the mill is most important; the photographs show this clearly. The character of the liner will also affect the result; and the question arises whether a pronounced step liner will increase fracture by repeated impact, rather than by abrasion. Again, it would seem that, with a hard ore and a fairly coarse feed, impact would be necessary to insure reduction; that with a finely ground ore, sliming would be accomplished best by an abrasive action.

The investigations tend to demonstrate that, in calculating mechanical efficiency, insufficient attention has been paid to the evolution of heat that accompanies fracture and results from friction. Whether an economical recovery can be made of the heat so produced will be doubted, but it is evident that no harm is done in most instances. In other cases, however, the evolution of heat is harmful as well as helpful to the operation—in the spreading of gold leaf by impact hammering, for example. The heating of the gold during this operation is so evident that especial care must be taken to avoid damage to the skins, which are expensive. This circumstance explains why ancient methods for the beating of gold are universal. The use of mechanical equipment has not proved practicable.

The investigations being conducted at Toronto University, we believe, will be constructive in suggesting that conditions of pebble load, feed, speed and moisture may be varied according to the character of the feed and the work to be done. The researches, when completed, if finality will ever be reached in so broad a subject, will constitute an important addition to the science of ore dressing.

Local Doings in Goldfield

AN EASY WAY to temporary notoriety is to turn prophet—about something that inflames men's imaginations. That is why the prophet of rich ore deposits, the seer of invisible rich mines, has an easy run for a brief period. Educated men fall for this psychic trap as easily—almost—as the ignorant. Tap a man on his bursal ganglion—his pocketbook nerve—and he goes to sleep with a beatific smile on his face.

Our correspondent, under Discussion, sends us news and comments concerning a Goldfield prophet who has "arisen"—one Bill Guest. Bill is evidently the cat's pajamas, if we may be permitted to say so, around Goldfield. He has located an oil well and prophesies gas at 600 and 700 ft., and high gravity oil at 2,200 to 2,500 ft. That gives Bill quite a little time. More than that, he has located a prophetic gold mine, with an appropriate name—the Yellow Cat. Now, the Yellow Cat gets $2.80 at 35 ft. "in the talcy formation beneath the manganese of last week," according to the *Tonopah Times*. There are plenty of assayers in Tonopah and Leadville and elsewhere who will find you more than $2.80 in an old rubber boot. If, however, the Yellow Cat has $2.80 at 35 ft., it should have $28 at 350 ft. and $280 at 3,500 ft. Hey, Bill?

"My Lady Nicotine" and the Bureau of Mines

IN THE SEETHING TURMOIL of modern times finality is difficult to achieve and equally difficult to recognize when suspected. Finality in research upon particular problems has a twofold advantage. It releases the scientist to engage upon other work and gives authoritative answer to questioning humanity.

Since Sir Walter Raleigh introduced tobacco smoking in England, the habit has spread over the world and has contributed generally to the joy of living. Doubtless the path of the salesman has been smoothed by the friendly smoke. Unquestionably many a conference has avoided physical violence by the presence of a majority of smokers, who, under the quieting influence of "My Lady Nicotine," have kept their colleagues within bounds. Steinmetz was an inveterate smoker and solved his abstruse problems in an atmosphere of tobacco smoke. Inspiration has been stimulated and logical thinking induced by this human habit. Nevertheless, the habit itself has not escaped the suspicion that it might undermine the physical well-being of the individual who indulges. Meddlesome reformers have sharpened their axes and have attempted to hew off this limb from the tree of happiness. Scientists have investigated the subject, and here and there may be found the results of their study.

Apparently the subject has not been sufficiently investigated, and this has come to the attention of the Bureau of Mines' investigators, with the result that an exhaustive study has been made. Serial 2,539, no doubt, is the concentrated essence of the work of the three investigators assigned to this work. It removes all doubt upon the subject, and is, moreover, authoritative in that it has the government's approval. It attacks the heart of the problem by assigning the deleterious rôle to carbon monoxide.

All pipe smokers will be cheered by the failure of the investigators to find any appreciable amount of carbon monoxide in the fumes produced by a normal pipe. As a result of the smoking of sixty popular brands of cigarettes in an unventilated closed room of 1,000 cu.ft. capacity, carbon monoxide was found both in the atmosphere of the room and in the blood of the happy smokers. The comparison between the results of smoking twelve good-grade cigars and sixteen good-grade stogies of Pittsburgh make gives assurance that good-grade cigars are safer than the rougher breed. All experienced cigar smokers have had a suspicion of this, but the authoritative determination of their relative merits by the Bureau of Mines is a distinct scientific contribution.

All smokers will likewise be glad to know that the reason why a smoker who inhales does not absorb more monoxide in his blood is the fact that the concentrated smoke does not reach the alveoli of the lungs. Disappointment also awaits the reformers when they learn that the maximum concentration of carbon monoxide drawn into the lungs is no higher than may be present in the streets of some of our larger cities where automobile traffic is heavy. Thus finality in research is achieved in this subject, and credit is due the Bureau of Mines.

King Oil

THOUGH AMONG MANY MEN there are many minds, once in a blue moon all seem to think alike on certain subjects. News comes that Harry Sinclair has been offered the kingship of Albania, the job that Prince William of Wied threw up so hastily some years ago. At once the thought occurs to us, as well as to more than one contemporary, what an excellent Minister of Natural Resources ex-Secretary Fall would make! It may be that Mr. Sinclair does not want the job. There are easier ones, and safer, than wearing purple in the Balkans. Disinterested advisers will tell him not to take it. But should he decide to take another chance, we urge upon him the selection of Mr. Fall for the office mentioned. And perhaps he could use Secretary Hubert Work, M.D., as his royal physician.

Gold or Iridium in Mono Lake

WE HAVE RECEIVED from the promoters of a plan to extract precious metals from Mono Lake, the following courteous letter, which we are glad to reproduce:

"Mono Lake, Calif., Oct. 30, 1923.

"Engineering and Mining Journal-Press,
San Francisco, California.

"Gentlemen:

"Sometime last spring, I think it was in your March issue, you called attention editorially to the claim that we were able to extract certain values in paying amounts from the waters of Mono Lake, California.

"The undersigned, who were responsible for the claims, at this time cordially invite you and associates, who might wish to accept this invitation, to come to our camp at Mono Lake and investigate our process for extracting metals in paying commercial amounts.

"We trust and hope that you will avail yourself of this invitation and would suggest that you advise us at your earliest opportunity, the time best suited to yourself; upon receipt of this advice, we shall be pleased to communicate with you further relative to details.

"Yours very truly,
"HERSCHEL C. PARKER,
"A. I. M. E.
"J. W. BROWNE."

Our information has been that the process was designed to extract gold from the Mono Lake water: but recently published interviews with Mr. Parker state that what he is seeking is not gold, but iridium. He is quoted by a Reno paper as saying: "However, the gold of the waters of Mono Lake is not what I am after. It is the iridium which I have found present in amount averaging about one-tenth ounce to the ton. The gold is merely a byproduct." The reporter rightly concludes that one-tenth of an ounce of iridium per ton of water, with iridium at $270 an ounce, "amounts to a fair chunk of money."

We do not wish to condemn anything that has possible merit; we do wish to save investors from hopeless and fantastic schemes. We have no facilities nor time for technical investigations, so we referred the inquiry suggested to us by Mr. Parker to the Bureau of Mines. In reply we are informed by Dr. S. C. Lind, chief chemist of the Bureau (who was until recently in charge of the Bureau of Mines Precious Metals Experiment Station in Reno) that about a year ago Mr. Parker called at Reno after having spent the summer at Mono Lake and presented a process "for recovering gold from Mono Lake waters, which he claimed was present, and which he had been able to find by ordinary assay methods to the extent of about 90c. per ton of water, 50c. of which he claimed was readily recoverable. He furnished us with a sample of the water, which we analyzed by three different methods and failed to find anything exceeding one-half of one cent per ton. As we were not sure of our reagents within this limit, and found about the same amount regardless of the method employed, we attached no credence whatever to his claim. Had iridium or platinum been present in commercial quantities, they would have been detected by the methods which we employed."

We are bound to consider this as authoritative, and feel obliged to warn all investors against any scheme to extract metals in paying quantities from Mono Lake.

Leonia's Clean-Up Delayed

THOUGH ALREADY LONG DEFERRED, the first clean-up of the Idaho Gold & Ruby Mining Co., at Leonia, Idaho, is to be further postponed. In fact, the fantastic scheme for recovering gold in a wholesale fashion by moving the gravels through a 1,600-ft. canyon and 300-ft. bedrock flume is now admitted to be impracticable. This is a hard blow for those who have been led to put their time and money into the project for so many years. An accident removed the chief promoter from this mortal coil last spring, and it will, of course, be hard to pin the blame on anyone.

An odd thing about the scheme is that even after so much work has been done, with so much publicity, it seems to be difficult to get more than vague estimates of the gold content of the gravel. How fickle values are! When most counted on they are often wanting, particularly when arrived at via an optimistic guess. Witness Boston & Montana, which "flopped" so hard last year, as any other similar enterprise must do when the time for the showdown comes.

The Idaho project is now to be worked by the "old-fashioned, reliable riffle system," as an apologist for it writes. By all means, if it will hasten the clean-up which we all are expectantly awaiting. But experience makes us pessimistic, and we have a feeling that at the proper moment, when the eyes of the world turn toward Leonia, another excuse will be forthcoming.

Royal School of Mines Alumni

ALUMNI of the Royal School of Mines, London, are requested to communicate their present employment and address to S. J. Truscott, the Royal School of Mines, London, S. W. 7. The information is requested to keep up to date the Register which was published about three years ago. "The idea in keeping old students together in an association," writes Mr. Truscott to us, "is that such a body has a great influence for good upon the present and future school."

Pacific Mining News Index

THE INDEX for Volume II of the *Pacific Mining News* has been completed and copies will be mailed to those who desire the index on receipt of request at our San Francisco office, 883 Mission St., San Francisco.

Professional Status of Mining Engineers

An Interview with Frank L. Sizer

FRANK L. SIZER first practiced as a mining engineer in Montana, where he was chief engineer of the Colusa-Parrott mines, in Butte. He was general manager of the Rosario mine, Guadalupe Y Calvo, Mexico. He came to California in 1909, as superintendent of the Balaklala Mines, Shasta County. After this he went to Arizona as mine superintendent and returned to California in 1915, where he has since practiced as a consulting engineer.

Mr. Sizer was asked to discuss the present status of mining engineers and the field of professional practice. He said:

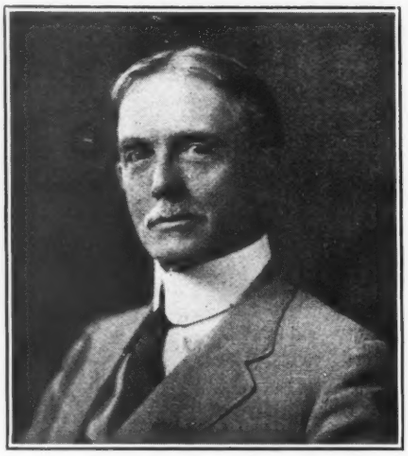
"The present-day demands upon a mining engineer are so great that very few men lay claim to ability to cover the whole field. The 'specialist' is therefore recognized as a necessity. However, he can only make good and convince the hard-headed business man when he is competent. It is a common practice in the case of any important mining enterprise to require reports and estimates from electrical, mechanical, and metallurgical engineers, as well as the mining engineer, in deciding the paramount question, Will it pay?

"Rarely does the possession of a large orebody assure assistance to the miner from the capitalist unless all the factors influencing production are favorable. Therefore, the mining engineer must have at least the ability to select specialists and to correctly interpret their results with reference to ore production and treatment that may be under consideration. Keen business men prefer a concise statement of the opportunity offered to make a profit out of the mine in question, rather than an abstruse discussion of the geological and mineralogical characteristics of the particular ore deposit.

Compensation for Engineering Service

"I find a wide divergence of opinion among engineers with respect to the value of their services. In general there is less likelihood of a client being overcharged than in the corresponding case of a doctor, lawyer, or an architect who furnishes high-class technical advice. In most instances of short-term employment, the engineer can do no better than to fix a per diem rate in advance. The client must trust to the engineer's honesty of purpose in allotting only the necessary time, and no more, to the work. In instances where a prospective client has ventured the opinion that no more than two or three days need be spent in mine sampling and examination, I have suggested that the accessory data to be gathered and interpreted may mean more in terms of days than the total time required for the sampling of ore faces and measurement of orebodies. In the case of raw prospects, it may be that an engineer's discrimination and ability to compare any given surface showing with others of a similar character will be worth more in money value than any amount of time spent in sampling or in purely geological investigation. A flat fee under such circumstances would be more just and reasonable than a per diem charge.

"Fees and their collection are indeed a vital and legitimate subject for discussion and I have found that engineers in comparing notes are quite ready to adopt a middle course that will be satisfactory to a reasonable client.



Frank L. Sizer

"The use of a professional card in one or more of the technical journals is conceded to be the only proper method of bringing one's name and qualifications to the attention of the public. I believe that a judicious assertion of an engineer's particular specialty, by letter to those who may inquire, or verbally if opportunity offers, is the natural and proper way. It is ethical for any man to emphasize his achievements by taking part in discussion and by giving to his fellow engineers such results of examinations, experiments, and development of processes as may not be the private business of a client. This may become public property after several engineers have arrived at similar conclusions, possibly for different clients, and the results may be as fully public and free for the use of all concerned as an article on which letters patent have been refused. Each case will be subject to restrictions which any thinking man can readily determine for himself.

"The more successful companies now make a practice of furnishing all cost data to any authorized mining operator, and this interchange of information always leads to betterment of methods for the giver of the data. The old-time close mouthed and mysterious mining superintendent is now rarely found and when encountered he is recognized as 'behind the times' and not likely to catch up with modern practice. Wild statements of cost are occasionally current, particularly with reference to copper, and this tendency of the mine owner and the small operator to minimize the prospective operating cost of his mine, and thereby promise greater profits, is misleading and embarrassing to the engineer in his relations with the 'essential' capitalist who needs to be shown but cannot always reconcile himself to the employment of a high-priced engineer.

"Promotion, a more or less tabooed subject in the estimation of many good fellows, is naturally combined with the business of mining and has a relation to the strictly engineering advice given to the buyer or to the seller. An engineer who can make a report so wholly 'uncolored' as to defy its consideration as a 'selling' or a 'buying' report has accomplished something worthy of imitation. For example, having examined for an owner a prospect which can properly be described as 'promising,' and where the owner has not the necessary funds to carry out a suitable development program, it is clearly within the province of a mining engineer, in my opinion, to present the opportunity to any company or individual known to be financially able to buy and develop it. For such service the engineer is entitled to a reasonable percentage upon the selling price paid by the purchaser. This presupposes that the engineer has first secured from the owner the lowest price and best terms obtainable, which would be better than the terms given by the ordinary promoter. In most instances, the engineer can save the buyer more than the amount of his percentage because of the fact that he will have shown the owner of a mine the difficulties and the hazards which intervene between initial operations and the dividend period.

The Engineer as a Promoter

"In my opinion, it is clearly the duty of an engineer to bring the buyer and the seller together. For this service he is entitled to compensation, without necessarily classing him with the promoter, who will exact as large a commission as possible, merely for an introduction of the seller to a possible buyer. In the instance cited, the mining engineer has gone on record as to the merit of the property before negotiations with a possible buyer, and the honesty of his action cannot be subsequently questioned. It is his duty to safeguard the interests of the buyer, by adjusting any differences and assisting in making the final terms such that a successful outcome will result, dependent only on nature's liberality and the price of the metal which is produced."

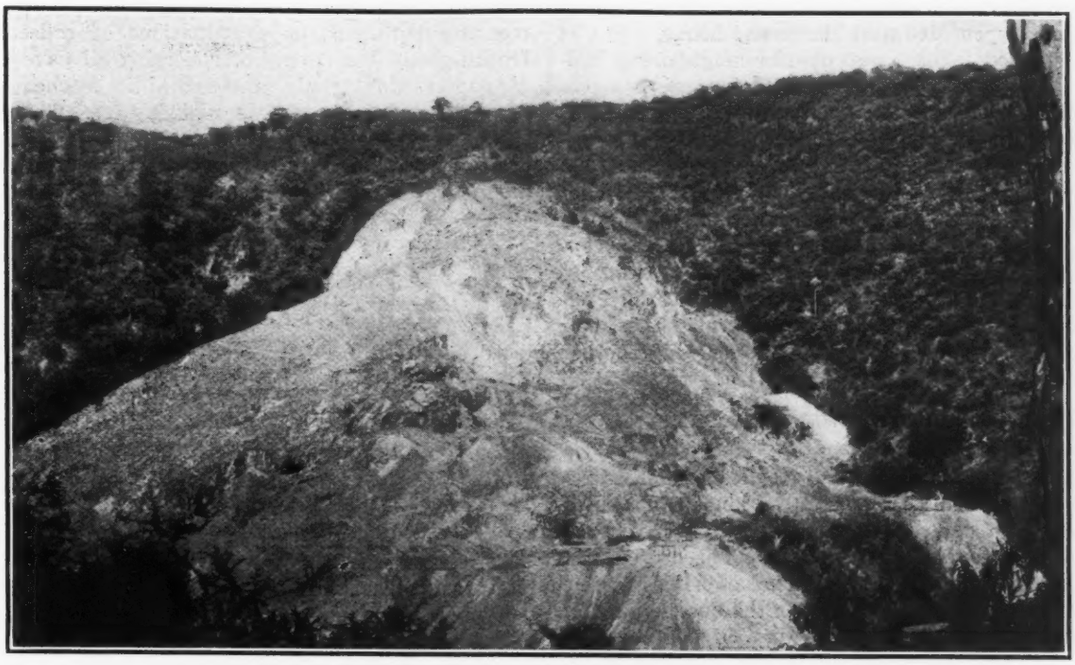


Fig. 1—Outcrops at the Cia. de Cobre Magistral-Ameca, showing native workings
This view was taken at the widest point in the vein, where it is 600 ft. from hanging wall to footwall.

Selective Flotation a Feature at the Magistral-Ameca Plant

A New Combination of Oils Is Used for Separating Copper and Iron Sulphides at This Property in Jalisco, Mexico

By Henry Mace Payne
Consulting Mining Engineer, New York

MEXICO, in addition to many large and important mining companies, has several small mining properties that are interesting, and among these is the Cia. de Cobre Magistral-Ameca. Operations began about fifteen years ago. The property was an antigua, lying 13 km. south of Ameca, Jalisco, worked for *magistral* (copper sulphate) used in the patio process, and the output had been shipped to Guanajuato and Zacatecas for many years, up to the time of the demonetization of silver and the subsequent introduction of modern methods. The native operators "high graded" and opened up a number of other mines throughout the district, among which were the Cerritos and the Zapote properties, adjoining the Magistral-Ameca. Eight or ten small smelters are still in evidence in the valley, where carbonate ores were made into kitchen utensils, kettles, and similar small articles.

Drill holes, surface indications, exploration of old works, and the present development indicate that the three veins shown in Fig. 4 not only consolidate under the andesite capping to the east, but in the quartz to the west, and at approximately 450 ft. below the main tunnel, the andesite horses entirely disappearing so that the three-part lode may be considered as one vein, No. 1 forming the hanging wall and No. 3 the footwall. This outcrop is clearly visible for 4½ miles east and west.

The present company's development consists of an upper tunnel, a main tunnel, and a vertical shaft extending to the 150-ft. level and designed to cut the hanging wall at approximately 1,800 ft. This shaft is now being sunk to the 300-ft. and 450-ft. levels, and to facilitate the work a dam is being built across the 150-ft. level to cut off the acid water, which will be raised to the surface by a brass-lined station pump of 200 gal. per minute capacity. The shaft has three compartments, each 4 ft. 6 in. x 4 ft. 6 in. in the clear. Hoisting is effected by an Ottumwa hoist, with ⅞-in. rope, for which power is supplied by one 100-hp. boiler, with one 50-hp. in reserve. A 10-kw. dynamo is operated by a 15-hp. Atlas engine, supplying the mine and the camp with light. The drilling equipment consists of an Ingersoll-Rand compressor, mounted Jackhamer, and Baby Leyner drills, and an Ingersoll-Rand No. 21 stoper. Industrial tracks are laid between wood yard and power house, and the shaft, ore dump, and mill. Water is supplied from a dam built by the company in Cortapico Arroyo, 2 km. from the camp, and flowing

by gravity to the camp, power house, and mill. An auxiliary concrete storage tank, equipped with an emergency pump, is provided near the power house.

The fuel used is oak, cut on the neighboring hillsides, and sold by the *cartabon*, which represents a pile of wood 5 ft. x 12 ft. x 2 ft. 6 in. (1.18 cords) and weighing approximately three tons. The average consumption is four *cartabons* (4.7 cords) per twenty-four hours, and the cost is 10 *pesos* ($5 United States currency) per *cartabon*, delivered at the yard.

Square sets of timber 8 in. x 8 in. x 17 ft. cost 6 *pesos* ($3) to cut and frame, and are placed by day labor. A complete set cost 45 *pesos* ($22.50) unframed, consisting of posts, divisions, wall plates, end plates, and 2-in. plank lagging. The cost of framing is 3½ *pesos* ($1.75) and of placing is 5½ *pesos* ($2.75).

Interesting Development in Use of Flotation Oil

That part of the lode known as No. 1 averages 8 to 9 per cent copper, with a trace of silver and gold; No. 2 averages 4½ to 5 per cent copper; and No. 3 averages 7 to 8 per cent copper where stoped. The ore carries considerable pyrite in addition to chalcopyrite. Owing to the fine dissemination of copper in the quartz gangue, water concentration yielded less than 50 per cent recovery and it became necessary to evolve a system of selective flotation which would pick up the chalcopyrite and not the iron. The ores now coming from the lower level are largely bornite and chalcocite. While experimenting with various combinations of collecting and frothing oils, the supply of collecting oil gave out, and *chapapote* was tried. *Chapapote* is a cheap, crude, heavy, Mexican oil with an asphalt base. This was too thick, and attempts were made to thin it, first with coal oil and then with turpentine. The latter gave too much froth. It then occurred to G. E. McCormick,

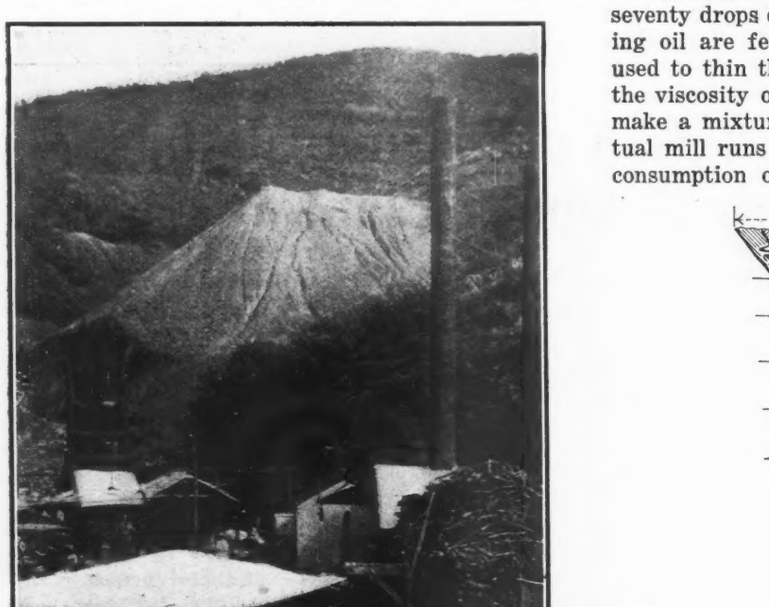


Fig. 2—Taken at right angles to Fig. 1, and showing the headframe of the shaft, power house, wood yard, beginning of ore dump, and track leading to mill

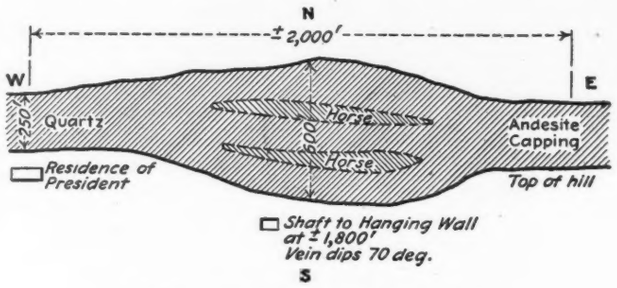


Fig. 3—Ground plan of the outcrop

vice-president of the company, to thin down the *chapapote* with gasoline. The result was eminently satisfactory from the start. G. N. S. No. 5 is used for the frothing oil. When the Marcy mill is operated at 24 r.p.m., grinding 100 tons of 4 per cent ore per day, seventy drops of collecting oil and thirty drops of frothing oil are fed per minute. The amount of gasoline used to thin the *chapapote* varies slightly according to the viscosity of the latter, it being merely sufficient to make a mixture which will drop freely. Based on actual mill runs of several thousand tons, the maximum consumption of oils per metric ton of ore is 0.3 lb.

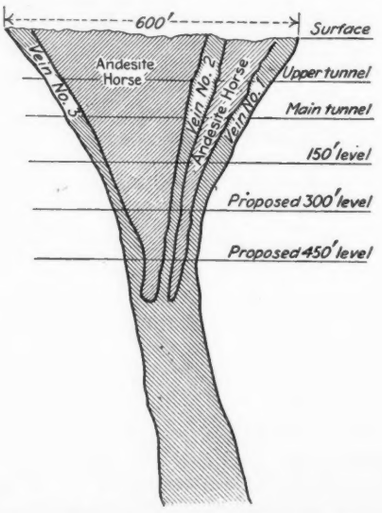


Fig. 4—Cross-section of outcrop at its maximum width, showing assumed character at depth

chapapote, 0.1 lb. *gasoline*, 0.1 lb. G. N. S. No. 5, the first two being used for collecting, the last for frothing. This makes a maximum of 0.5 lb. of all oils combined, per metric ton of ore. The *chapapote*-gasoline mixture costs ⅔c. per metric ton of ore (United States currency) and 1⅓c. per metric ton provides the G. N. S. No. 5, or a total cost of 2c. per ton of ore for all flotation oil used. These figures have been demonstrated again and again at this plant, and reflect the success of this development in selective flotation so far as the oil used

Fig. 5—In one of the old stopes of the main tunnel. Leaching of the pillar in the center may be clearly seen

is concerned. For a richer ore, a slight increase in the amount of oil is advisable.

Fig. 6 is the flow sheet. The No. 1 K. & K. machine gives clean concentrate. The No. 2 K. & K. gives a clean tailing and low-grade concentrate. A recovery of 97 per cent can be made here at the expense of lower-grade concentrate. The No. 3 K. & K. recleans the concentrate from the No. 2 and the tailing is returned to the Marcy mill for regrinding. The concentrate from the No. 2 K. & K. goes to either the Dorr thickener or the No. 3 K. & K.

The Dorr classifier is set to overflow at 60 mesh, and is regulated by the addition of water. The mill itself, shown in Fig. 7, is equipped with two 80-hp. boilers and one 60-hp. Ball engine. On clean sulphides the actual recovery is from 92 to 98 per cent. The daily average is from 93 to 95 per cent on steady mill work, making a 26 to 28 per cent concentrate. The ore from the lower levels is a particularly clean sulphide, which makes an ideal flotation ore. The selective process, due to the *chapapote* gasoline combination, is clearly a distinct advance both as to simplicity, cost, and high recovery.

In addition to the property described, the company also owns and is developing La Breccia, two miles north, consisting of 167 *pertinencias*. The principal rock is tertiary andesite, with a series of basaltic dikes relatively parallel. The granite crops out on the adjoining ridges both north and south. The valleys between are volcanic. On the Magistral property the andesites are highly silicized, shading into quartz. On La Breccia the andesites carry copper-bearing minerals both in veins and in a brecciated area at present under exploration. The development work, done by bore holes, test pits and trenches, has already exposed a vein 300 ft. wide, with a superficial area of 270,000 sq.ft., extending to an unknown depth, and carrying 2 per cent copper in the form of chalcopyrite. An old shaft 68 ft. deep is still in ore of the same formation and character, and at another point on the property a fault has been

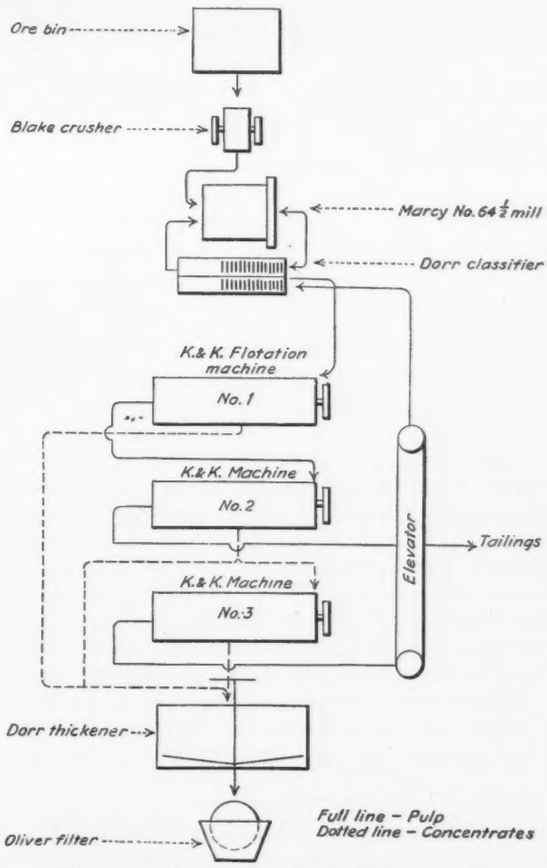


Fig. 6—Flow sheet of the flotation plant

analyzed to show an orebody depth of at least 127 ft. The prospected area alone will yield 62,000 metric tons per meter in depth, and it is planned to drill the property to a depth of at least 300 ft. To the north an andesite cap of later flow occurs, and 1,600 ft. farther is andesite breccia still in the carbonate zone, and with the same horizon equally mineralized. Mount Tetilla is an extinct volcano rising 7,000 ft. above sea level, and lying 4 miles west, and the fracturing of the entire district apparently radiates from it.

The andesite breccia, the origin of which is not clear, is cemented by a black mineral, presumably ferromagnesian silicate. Microslides are now being prepared, and photographic studies will be made. An interesting home-made microscope has been devised by Walter Neal, superintendent of the company. An old transit, whose days of usefulness had passed, was uti-

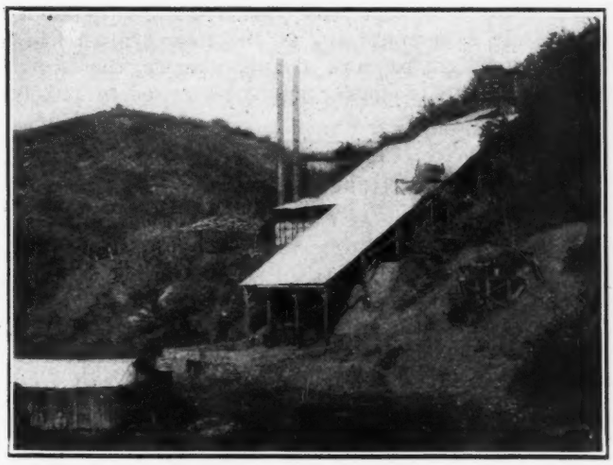


Fig. 7—Exterior view of the mill of the Cia. de Cobre Magistral-Ameca

Fig. 8—An open-air laundry made possible by piping water about the camp

lized. The eye-piece slide was removed from the telescope and wired securely in the opposite direction to the objective slide, a small block of wood being fitted between. A small object plate was attached to the end of the level bubble tube on the inverted telescope. The focusing of the objective slide is utilized for focusing the attached eye-piece lens, and a serviceable microscope is thus made.

On account of the acid water from the mine, the water from the Cortapico Arroyo, referred to previously, is piped to all parts of the camp, and laundry places are provided as shown in Fig. 8.

The extremely large tonnage already developed, and the promising areas now under exploration, with the advanced and cheap process of selective flotation in use, have given to this section of the State of Jalisco the name of the "Butte of Mexico." An excellent automobile road has been built by the company from the city of Ameca to the mine. Railroad transportation is had by the National Lines of Mexico from Ameca, with daily train service. Upon the completion of the development work now in progress, the Magistral-Ameca will be the center of another great copper-producing district.

Platinum Lode Found in Transvaal

A recent discovery of platinum in Northern Transvaal has been described as one of the most remarkable occurrences of that metal ever found. According to the *Journal* of the Chemical, Metallurgical and Mining Society of South Africa, for September, the deposit is in a quartz lode in acid country rock extending over a considerable distance. The lode in question is a brecciated quartz filling in a fault or fracture plane in the felsite of the Bushveld complex, and varies from 1 to 30 ft. in width. Its location is in the Waterberg district about 24 miles north of the town of Nylstroom and about 100 to 110 miles north of Pretoria. The lode matter consists of a brecciated quartz filling with angular inclusions of felsite. Specular iron ore and a highly ferruginous silicate are accessory minerals, together with a small amount of chromite. There is much secondary quartz. The unbroken outcrop resembles hundreds of other quartz outcrops in this country. The rock is harder than the felsite, and where not covered by overburden the outcrop stands out prominently above the surrounding country. Freshly broken ore shows a laminated arrangement of alternating bands of white and red or pink, or appears as an agglomerate with sharp red fragments of felsite in a groundmass of white quartz. Up to the present no type of lode matter in particular has been found to carry platinoid values.

The platinum in the ore is generally very fine, though quite coarse, nuggety pieces are sometimes seen. The work so far done is in such an early stage of development that not sufficient data have been collected to throw out any hypothesis as to the formation of the lode and the genesis of its metallic content. Also, whether or not the deposit is of commercial importance has not yet been proved.

The Avonmouth Smelter

It really seems as if at last some use was to be found for the huge spelter plant erected during the war at Avonmouth, according to the London *Metal Bulletin*, which believes that the National Smelting Co., the owners, have now acquired the Swansea Vale plant, and in addition, a large block of shares in the Burma Corporation. Apparently by way of financing these transactions, the National Smelting Co. will offer for public subscription £1,500,000 7 per cent mortgage debentures. The capital of the National Smelting Co. is at present £650,000 8 per cent cumulative participating preference shares, £1,000,000 ordinary shares of £1 each, and £50,000 deferred shares of 1s. each.

It is stated that the Avonmouth property and that of the Swansea Vale Co. represents total capital expenditure exceeding £2,000,000. The transaction should certainly be of help to the Swansea Vale plant, whose retort capacity is known to be well ahead of its roasting facilities.

Whether the Avonmouth plant, although designed for an annual output of 60,000 tons of spelter, will eventually produce metal, may be left to the future to show, but at all events it can be used as a roasting plant. In this capacity it should be serviceable to Swansea Vale, and should render it possible greatly to increase the spelter output there. Swansea Vale has its own contract for the supply of Broken Hill concentrates, which will keep its requirements covered up to 1930, after which time it will no doubt be able to draw upon Burma concentrates, which are similar in character to those coming from Broken Hill, and cargoes shipped to Belgium for treatment have yielded quite satisfactory results. If Avonmouth and all the other United Kingdom smelters got to work at full capacity, the United Kingdom output of spelter might be raised to 110,000 tons a year.

Norwegian Nickel Refinery Resumes

The nickel refinery at Christiansand is about to resume operations, says *Commerce Reports*, as a result of an agreement with the Norwegian Government for the remission of unpaid state taxes and a more favorable nickel market. This refinery began operations in 1910 for the refining of nickel and copper and byproducts from smelters at Evje and Ringerike and from imported ores. In 1916 and 1917 about 80,000 tons of ore was treated, worth from 2,000,000 to 2,500,000 Norwegian crowns. During the following three years production decreased until the company was forced to close down on account of inability to compete.

Trade Statistics and the Non-Ferrous Metals*

The Present Service to the Mining Industries and How It May Be Improved

By Felix Edgar Wormser and Edward H. Robie
Assistant Editors

THE NON-FERROUS metal-mining industries are served by two kinds of statistics—non-secret and secret—by which we mean statistics given freely to mining companies and public alike, and those that circulate only among the producers who contribute to the gathering of the data. This classification does not include the statistical information supplied by the government and refers only to the tabulations made by the various metal-mining industries themselves, which are statistical records quickly accumulated, summarized, and distributed, and are the more useful to the producers and consumers of the metals. The government figures are generally compiled but once or twice a year and are usually issued too slowly for current application. In the last year or so, a trend toward a quicker publication of the figures is noticeable. It is doubtful, however, if government agencies will ever supplant private ones—trade associations—which are in close touch with their constituents, and can, and often do, make it their sole effort to procure vital statistical market information promptly and regularly throughout the year.

Illustrations of Divergent Policies

A good example of an industry whose statistics fall in the non-secret class is the zinc industry. The zinc producers of the United States have an association which, without fear or favor, promptly gives publicity to figures showing accurately and intimately the momentary statistical position of the zinc-smelting industry. That is, a monthly statement of production, shipment, stocks, and shipments abroad is given, and also the number of retorts in operation at the smelters, which is an index of the activity at those plants. On the other hand, the copper, lead, and silver producers collectively believe in secret statistics. Although they are provided with information similar to that supplied by the zinc associations to its members and the public, this information is given a restricted distribution, principally among the officers of the companies supporting the service.

Evidently there are two conflicting policies in the non-ferrous metal-mining industries regarding the release of statistical records—one favors the utmost secrecy and the other frank and free publicity. It is interesting to observe that some large mining and smelting companies that produce several important non-ferrous metals accept this veil of secrecy for, say, copper and lead, and in the case of slab zinc are satisfied with the present policy of full publicity. In examining the reason for this situation we believe that certain constructive steps might be taken to bring about not only a more uniform attitude on the part of the producers but also to provide them with even more valuable statistical information than they now possess.

Let us first examine the condition in zinc. Not so very many years ago this great American industry was accused of being one of the most backward and unprogressive of metal industries, especially from a production standpoint. Technical co-operation was practiced by but few zinc companies. Many of them denied admission to their plants to competitors and interested engineers—a circumstance rare indeed among the copper producers. In fact, some zinc companies today are still imbued with archaic notions of aloofness. Numerous zinc producers felt that they had more to gain by steering their own independent course than by being helpful technically to their fellow producers, and the fact that an exchange of technical information would be mutually beneficial did not seem to sway them. It was only during the war, when the need for organizing and operating the zinc mines and smelters of the country most efficiently was recognized, that producers began to mend their ways. An association of producers was formed which, a few years later, developed into the American Zinc Institute. It is this organization which gathers the statistics of the industry. Miners, smelters, manufacturers, and dealers comprise its membership, which has now become so comprehensive that fully 95 per cent of the zinc production of the United States is represented in it.

The American Zinc Institute is essentially a trade association, and the statistics compiled by it come in the category of trade association compilations. Inasmuch as the trade association has been criticized and often condemned for its secret handling of statistical information, the directors of the American Zinc Institute decided, soon after beginning its statistical work, that all data digested from the reports of the producers would be given prompt and widespread publicity. At the same time the decision was made to let matters of price severely alone, so that no possibility of violating any federal business law should arise. The system has worked splendidly in practice and has furnished the zinc producers with a service which they would sorely miss should it be suspended. Like the telephone, one wonders what was done before it came into general use.

How the Other Metal Industries Are Supplied With Statistics

The copper, lead, and silver producers have no association corresponding to the American Zinc Institute. They obtain their information from a central organization formed purely for statistical purposes. They submit to it monthly statements of production, deliveries or shipments, and stocks. These figures are integrated, and a summary is distributed to each contributor, with the understanding that such data are to be held confidential. But, like most confidential information of this sort, the statistics usually filter through the producers' hands to newspapers, or trade papers, and to the public. This is easy to explain. When the statistical position is sound it may be to the advantage of some producer to let everyone possible know of it. On the contrary, when the market position is unsound, a speculator with the figures in his

*A paper presented at the eighty-fifth annual meeting of the American Statistical Association, Washington, D. C., on Dec. 28, 1923.

possession, and taking the "bear" side of the market, may deem it advisable to let the unfavorable figures appear in the press. Personal motives have much to do with a leak of the figures.

It also frequently happens that, in the effort to publish statistics promptly, particularly those of copper, financial papers will publish statistics that have no basis in fact; in short, merely distorted estimates. Although these are not always regarded seriously, they may have a bad influence.

Until a year or two ago, it was the general practice of the individual copper-producing companies to release monthly production figures. Then some of them ceased to do this, but others continue to do so, and see no harmful effect therefrom. In fact, there is little gained from an effort to keep monthly production secret, for the figure is usually known locally at the mine or smelter by so many people that it can be easily learned by a reporter or correspondent on the ground. The attitude of the copper producers seems to have been carried to absurd extremes.

No Advantage in Secret Compilations

Should one approach the copper, lead, or silver producers with the question "Why do you insist on keeping your statistics secret?" a variety of answers would be forthcoming. Some of the producers sincerely believe they have a certain trade advantage by acquiring statistical knowledge not in the hands of consumers. Others advance the more logical reason that to divulge the data would give the consumers a benefit to which they are not entitled and which is not reciprocal. That is, consumers would be able to judge the situation in the metal industry supplying them with their raw material, and at the same time would know their own position relative to stocks on hand, material in process, and prospective shipments. They would have a more comprehensive market picture than the producers. We feel that the metal producers have some justification for this attitude, although it is doubtful if they gain anything by it. In fact, measured in dollars and cents, or in the avoidance of violent fluctuations in the copper market, probably nothing is gained. How could it be otherwise? Statistics in the metal industries can be interpreted so differently that if they are used as an infallible guide to the future of any commodity they are likely to be seriously misleading. Non-ferrous metal statistics are not on a parallel with those gathered in agriculture, in wheat, cotton, and sugar, in which estimates of prospective yield are exceedingly valuable in any analysis of market conditions. The production of these commodities depends upon the acreage planted, the vicissitudes of the weather, and the ravages of insect pests. Not so with the metals. Their production is easily varied and depends upon the policies of individual producers. At best the statistics of the non-ferrous metal-mining industries can only be construed broadly, or they are given a false importance.

Copper Subject to Sharp Price Fluctuations

It is interesting to note that although the copper-mining industry is supplied with exhaustive monthly statistics of production, deliveries into consumption, and stocks, the copper market is noted for its violent fluctuations. The two have probably no direct connection, but, armed with valuable statistical data, copper producers have not been able to avoid these harmful rises and declines in prices. Just a few weeks ago electrolytic copper advanced nearly $\frac{1}{8}$c. per lb. per day in price for six days. In other words, the value of the metal increased 7 per cent in one week. The following week it declined just about as rapidly as it had advanced. Some of the heaviest sales of the year were made on the advance, and one can imagine the feelings of consumers who must buy a commodity which fluctuates so violently in price. As no facilities exist in the American market for hedging, the risk of the buyers is great.

So far nothing has been said about tin statistics. This metal is not produced from domestic ores, and in fact it is now smelted to only a small extent in this country from foreign ores. Nevertheless, as half the world's production of tin is consumed in this country, knowledge of the stocks and current and probable future supplies is of importance to many of our industrial concerns. As most of the tin that is produced is under British control, and is marketed through two large dealers in London, the matter of statistics is largely beyond the control of any one in the United States. However, it is a fact—and this statement is of particular interest in view of the success of Britain as a commercial nation—that British companies collect and publish commercial statistics much more freely than do American companies. Mining is no exception, and we have therefore acceptable data on foreign tin production and stocks. There is, however, what is known as the invisible supply, which partly represents the stock of tin in the hands of consumers, and without this figure it is difficult to get an accurate picture of the industry.

The Meaning of Metal Exchange Quotations

In this country, the New York Metal Exchange collects and publishes the tin statistics from day to day. This exchange also supplies a report on the price of non-ferrous metals to a large number of newspapers throughout the country. However, the New York Metal Exchange is really an exchange in name only, for rarely is any trading done on its floor, with the exception of small dealings in tin. It is merely a meeting place for some of the New York metal dealers, largely for the exchange of market gossip. The prices of copper, lead, zinc, and some other metals there established are only nominal and should be so regarded by those who scan them in the press of the country. There are no authoritative complete daily reports of metal prices and sales on exchanges, as there are of grain, cotton, sugar, and many other commodities, where trading is done on an organized market. Instead, the industry must depend upon estimates of the business done as reported by trade papers and magazines, which estimates vary in accuracy with their source.

In New York, where the largest quantities of the non-ferrous metals are sold, daily trade papers such as the *American Metal Market* and *Daily Metal Reporter* devote their space exclusively to market news. The *Wall Street Journal* and some of the large daily newspapers usually give prominence to market information. The *Engineering and Mining Journal-Press* supplies a weekly market service to the non-ferrous metal and mineral markets. It is unique in being the only organ receiving records of sales from the largest producers—that is, the date, quantity, delivery, and price of transactions in the metals. This information is extremely valuable in enabling accurate quotations to be determined, which may be, and are, used as settlement prices

in the purchase of metals in ores, or the sales of the metals themselves. In fact, each year the aggregate amount of such business runs into many millions of dollars. Naturally this places a big responsibility on the shoulders of a trade journal. Independent—one might say umpire—determinations of daily market prices by the trade press instead of by a metal exchange is one of the outstanding features of the method of buying and selling metals in the United States. Incidentally, it is interesting to observe that these quotations are also often used by metal manufacturers in contracts they make with ultimate consumers.

Do the recipients of the statistical information act upon their interpretation of it? We have reason to doubt it, from more examples than one. The copper industry is an illustration. At present it is burdened with an overproduction. Monthly statistics have shown this repeatedly. Consequently the price of copper is abnormally, even ridiculously, low. Yet do any of the producers show any inclination to curtail production? On the contrary, some of them have actually increased it. This is only another illustration of the unreliability of statistical information as an indication of probable future action. The high-cost copper producers are running at the highest possible pitch to produce the metal as cheaply as possible. For a similar reason the low-cost mining companies are pursuing the same course. They are especially dependent upon large-scale production to produce copper at the lowest cost. Those copper producers who feel that the withholding of statistics from the public is desirable, can hardly point to the behavior of their market—which is the acid test to apply—as vindication of their belief.

The zinc producers are generally agreed that the publication of their summarized monthly records has not had any detrimental effect on their business. During the year about to close the zinc situation has varied from poor to fair. Prices have never moved sharply, so far as we have been able to judge, in sympathy with the showing made by any published figures, which is to be expected, as markets have a way of discounting favorable and unfavorable factors long before they are expressed in statistics. The zinc market in 1923 has moved slowly, at times upward, and then downward—a decided contrast to the erratic course of the copper market.

Oddly enough, the position of the zinc producers is even more vulnerable than that of the copper-mining companies. The slab zinc statistics are gathered from the smelters, who, unlike the copper smelters, are dependent for their ore supplies largely upon purchases in the Joplin ore market. Mining and smelting are two distinct groups of enterprises in the zinc industry. Miners and smelters negotiate each week over the price of ore. Thus, the figures compiled by the American Zinc Institute are subject to the scrutiny not only of consumers—such as galvanizers or brass manufacturers—but also to the examination of ore sellers supplying the smelters. The zinc smelter has, therefore, even greater reason than the copper smelter for withholding his figures from the public. That he doesn't and that no ill effects are observable from publication of the statistics is strong evidence that the prompt release of vital industrial statistical information does not work injury to the issuing agencies and their constituents. The enlightened policy of the zinc industry in regard to its statistics is most progressive and has led probably to a betterment of its position in commerce.

What can be done to improve the scope or quality of the information now gathered by the non-ferrous metal producers? An important forward stride would be to remove the objection some producers now have against releasing their own statistical compilations—that is, to obtain data regarding the state of the consuming industries. We have good reason to believe that if the manufacturer of metal products indicated a willingness to gather and supply such information the producers would be glad to exchange information and to make the whole story public. The data desired from consumers, lumped together, of course, would be the stocks of metal on hand, in process, and shipments arriving during the month, together with monthly orders and unfilled orders. Combined with the producers figures, what a splendid picture of each industry that would be: First the production of the raw material, stocks of it on hand at the smelters or refineries, deliveries during the month, then the amount of the consumers stocks, and sufficient data to gage manufacturing activity.

So far, consumers do not seem to have combined for the purpose of the interchange of information regarding their raw material to the same extent as the producers. The galvanizing interests are probably the best organized in this regard. It is said on good authority that every sale of zinc to a galvanizing interest is on the table of every other important galvanizer the next morning, with full particulars as to price, tonnage, delivery, seller, and buyer.

The interests of producers and consumers are not wide apart. Producers want a fair price for their product to insure a fair return on their investments, to which no consumer would find objection. At the same time they are both interested in having the market fluctuate slowly. A statistical picture of the whole industry from the production of the raw material to the manufacture and disposal of the finished product would be of great advantage and would help producer and consumer in smoothing those peaks and depressions in the price curve that are so disastrous to industry.

There would seem to be a fair prospect of bringing about this desirable result if both producers and consumers were approached by a disinterested third party who could be depended upon to prevent leaks of individual reports. The great value of the statistical summary, covering both producers and consumers, we believe would be admitted by all.

Iron Production in Europe

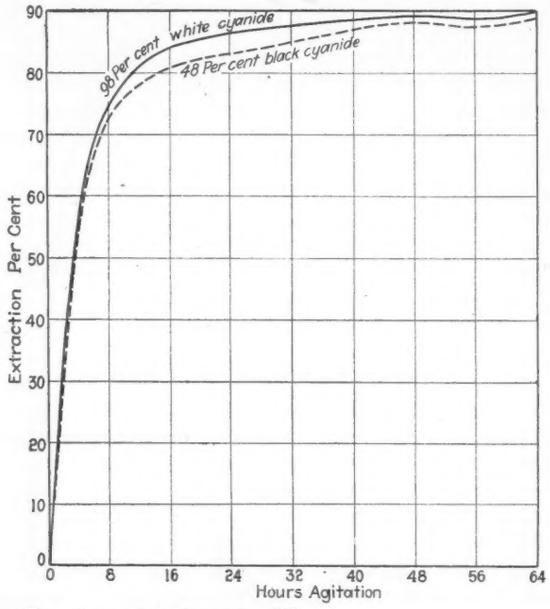
The recent changes of boundary between Germany and France have greatly changed the positions of these countries compared with that obtaining before the war, according to *Chemistry and Industry*. In 1913 Germany produced 16,764,000 tons of pig iron, Great Britain 10,425,000 tons, and France 5,207,000 tons. If the present boundaries, however, had been in force, these figures would have become 10,916,000 tons, 10,425,000 tons, and 9,071,000 tons respectively, omitting the output of the Saar region. Thus France has a capacity practically equal either to that of Great Britain or Germany. Moreover, taking into consideration iron works controlled by French capital in the Saar region, Luxemburg, Belgium and Czechoslovakia, the total output of pig iron under French control is 18,000,000 tons, and if the productive capacity of the occupied area is included this figure becomes 26,000,000 tons, or three-fifths of the total productive capacity of Europe.

A Comparative Test of Cyanide of Different Grades

By Fred C. Bond
New York & Honduras Rosario Mining Co., San Juancito, Honduras

THE mill of the New York & Honduras Rosario Mining Co. recently began using 48 per cent "Aero Brand" black cyanide in place of the 98 per cent white sodium cyanide which was formerly employed. Changes in local extraction in the various parts of the mill became gradually evident, and indicated the need of comparative solution curves, to obtain which the tests described below were made.

The purer white cyanide was added to a solution of tap water, nearly saturated with lime, in the proportion of 13 lb. equivalent KCN per ton of solution. The solution titrated: total KCN, 0.650 per cent; free KCN, 0.650 per cent; CaO, 0.115 per cent. The 48 per cent black cyanide was added to a similar solution in the same proportion. After agitating twenty-four hours and filtering through coarse filter paper the solution titrated: total KCN, 0.650 per cent; free KCN, 0.645 per cent; CaO, 0.100 per cent. An average mill head sample, assaying 28.17 oz. Ag and 0.055 oz. Au, was crushed to 7 per cent on 150 mesh, care being taken not to oxidize the sulphides. Eighty grams of this sample



Results of ore treatment with solutions of two different kinds of cyanide

and 1 gram of crushed lime, containing 60 per cent CaO, were placed in each of sixteen two-liter bottles; to eight of these were added 400 c.c. of the white cyanide solution and to the remainder, 400 c.c. of the black cyanide solution, the dilution being therefore five parts of solution to one of ore. The bottles, unstoppered, were placed on the rolls for agitation and one bottle of each solution was removed at the end of successive eight-hour periods, the filtered solution titrated for cyanide and lime, and the ore assayed for silver. The results obtained are shown in the accompaying drawing.

The extraction after fifty-six hours is seen to be lower in both instances than that after forty-eight hours, although with further agitation it again increases. This phenomenon has been repeatedly but not invariably noticed in the mill, and as yet no satisfactory explanation of it has been advanced.

It would appear that the black cyanide is the slower dissolving agent, but the fact that after twenty-four hours' agitation the two extraction curves steadily approach each other indicates that, locally, the cheaper black cyanide may be the more economical, especially where a few hours of additional agitation are possible. In other words, if further agitation is not possible for any reason, the saving in cost of cyanide may or may not counterbalance the somewhat larger silver loss, which will depend on the grade of ore. On the other hand, where agitation can be continued a few hours longer and where, therefore, the same extraction is obtainable, the initial cost of the cyanogen content of the cyanide is the chief point to be considered. The lime consumption is lower with the lower grade cyanide, owing to the lime that the cyanide itself yields on going into solution.

The specific gravity of the mill solution was 1.0054 when white cyanide was being used and rose to 1.0066 after three months' use of the Aero Brand, owing to the concentration of the soluble salts contained in the latter. The consequent increase in the viscosity of the solution is considered largely responsible for the fact that the silver is dissolved less rapidly. One calculation gives it as causing a lag of 2 per cent. The tests were made under the direction of Paul T. Bruhl.

Cyanide Consumption and Protective Alkalinity

	Hours' Agitation								
	0	8	16	24	32	40	48	56	64
Consumption of 98 per cent cyanide (in terms of lb. of 100 per cent KCN per ton)	.....	5.0	5.0	5.3	5.5	5.8	6.3	6.3	6.5
Consumption of 48 per cent cyanide (in terms of lb. of 100 per cent KCN per ton)	.....	5.0	5.0	5.0	6.0( )	5.5	6.0	6.0	6.5
Protective alkalinity titration 98 per cent cyanide, per cent CaO	0.115	0.100	0.112	0.0975	0.093	0.0875	0.0925	0.085	0.075
Protective alkalinity titration 48 per cent cyanide, per cent CaO	0.100	0.103	0.093	0.098	0.093	0.093	0.088	0.088	0.085

Dilution, 5:1. Solution strength, 0.65 per cent KCN. Head assay, 28.17 oz. Ag. Crushed to 7 per cent on 150 mesh.

New Hydraulic Classifier Developed

In the work on ore classification problems in treating complex lead-zinc ores of the Coeur d'Alene and other mining districts of Idaho, an improved type of hydraulic classifier has been developed by metallurgists of the Moscow, Idaho, field office of the U. S. Bureau of Mines. It is believed that this new classifier is more efficient than any now in use, and that it represents a distinct advance in metallurgical treatment. The new classifier has been tried out on a commercial scale in one of the mills, with the result that a greatly improved grade of classification is being effected. It is believed that table concentrations will be greatly improved when the tables are fed with good classified material. It also appears that with this type of classification, galena and sphalerite may be separated on tables into marketable products and that much of the fine grinding and difficult flotation treatment of complex lead-zinc ores may be eliminated. Intense interest in the trial has been manifested throughout the district.

The Chino Enterprise—IV

Methods of Prospecting and Mining

By T. A. Rickard

THE mining operations on a small scale that preceded those of the Chino company were confined to an area about 800 ft. wide and 600 ft. long, whereas the ore deposit as a whole may be considered to cover an area one and one-half miles wide, east to west, and fully two miles long, north to south. The recognized orebodies occupy a nearly circular space having a diameter of about 9,000 ft.

The ore-bearing ground had been sampled and drilled at the time the company was organized, but before any system of mining could be selected advisedly it was necessary to obtain further data concerning the distribution and extent of the ore; and as a preliminary to anything else it was necessary to prepare an accurate topographical map. This was done on a scale of 100 ft. to the inch, with contour intervals of 5 ft.

South benches in the Hearst pit

The prospecting of the ground was done systematically by means of churn drills, using the No. 6 Cyclone machine. Each drill was operated by a crew of three—a driller, a helper, and a sampler. Two crews, each working twelve hours, rendered the operation continuous. As the drilling progressed the rock powdered by the bit was made into a mud by feeding water into the bore. Any mud that adhered to the drill when it was lifted for examination was washed back. Samples were taken every 5 ft. in barren rock and every 3 ft. in ore-bearing ground, these distances being measured on the cable by which the drill is suspended. To collect the sample a container with a valve in the bottom was lowered into the bore, and was discharged into a launder leading to a split-shovel type of sampler. This arrested a quarter of the mud from the drill hole; if the yield was too bulky, it was passed again over the sampler. The final sample, amounting to about a gallon, was evaporated to dryness and then sent to the assay office.

Careful records were kept by each drill man. About 630 ft. per month was accomplished by each drill. The cost in 1912 ranged from $2 to $2.68 per foot. These figures I have taken from Bulletin 107 of the U. S. Bureau of Mines, published in 1916, by Donald F. MacDonald and Charles Enzian, who are to be congratulated on this excellent technical brochure. Given the data from the drilling, the estimation of the ore available was based upon measurements in the form of triangular prisms, the economic limit of "ore" being taken as 0.8 per cent, or 16 lb. of copper per ton.

Next, the orebodies were cross-sectioned by aid of the information given in the assay and drill records. Thus the shape and position of the various orebodies were visualized, for the purpose of guiding the systematic removal of the ore.

Any native copper detected in the drill sludge was weighed and recorded separately. In the diagrams the waste is not shaded, and so shows the relation of ore to reject. The heavy line marks the limits of what is "ore," as determined by the results of the churn-drill assays.

The method of estimating the tonnage of ore in reserve, as done, for example, in 1921, was shown to me by the company's engineer, A. G. Burns (University of North Dakota, 1910). Herewith are given several

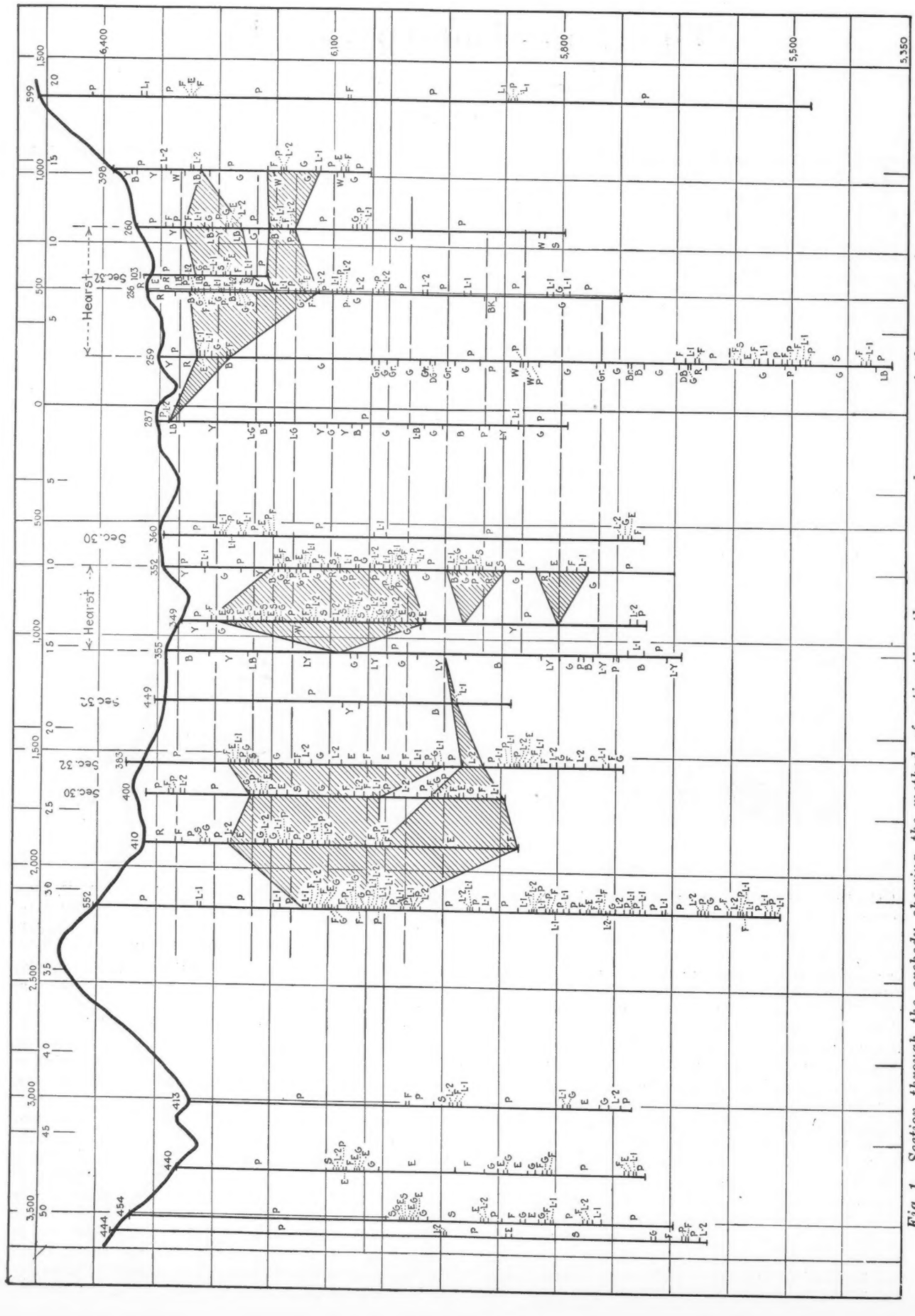


Fig. 1. Section through the orebody showing the method of estimating the ore reserves by means of the samples from churn-drill holes

sections northeast—southwest through a group of orebodies. The first, No. 31 (Fig. 1), shows on the left the Sierra orebody as outlined by drill holes 552, 410, 400, and 383. It will be noted that ore is cut at 6,235 ft. above sea level, or 110 ft. below the surface, and extends to 5,848. The horizontal length used in the estimate was 630 ft. The lettering gives the assay value of the ore as noted in the following table:

Symbol	Copper, Per Cent	Class
P	Up to 0.79	Poor
L 1	0.80 to 0.89	Low, No. 1
L 2	0.90 to 0.99	Low, No. 2
F	1.00 to 1.24	Fair
G	1.25 to 1.49	Good
E	1.50 to 1.99	Excellent
S	2.00 upward	Superlative

It will be seen that it would be reasonable to infer an extension of the ore to the left, but as no drill hole was sunk nearer than No. 413, which is 840 ft. south-east, no allowance was made for this probable extension. In the same way the extension north-west is evident from drill hole 383, but as the next hole is 270 ft. distant (at No. 449) no allowance was made, because the estimates were confined to ore within drill-hole intervals of not more than 200 ft. Proceeding northward we come to the south prong of the Hearst orebody, which is cut at a depth of 40 ft. and was traced—with two intervals of poor ground—to the 5,765 level, or 532 ft. below the surface. It must be noted that the horizontal scale of the original tracing was 200 ft. to the inch, whereas the vertical was 60 ft. to the inch, so that the orebodies are made to appear narrow in proportion to their length—that is, more chimney-like than they are. This causes an unfavorable distortion. Sections on a normal scale would not have sufficed to give scope for recording details. Here again drill hole 352 shows a vertical face of ore for 180 ft. extending northward, but this evident extension is not taken into account because the next drill hole, 360, shows lack of ore. Going north for 500 ft. we come to the north prong of the Hearst orebody as outlined by drill holes 287, 259, 256, 103, 260, and 398. Here ore begins at a depth of 15 ft. below the surface and extends down for 205 ft. Drill hole 259 cuts ore at 5,585, and this ore reaches to 5,398, a vertical extent of 187 ft. The top of the hole is at 6,325. This ore averaged 1.58 per cent. The outline of the pit shows how much overburden had to be stripped before the steam shovels began to dig in ore. The total length of this section (from bore hole 552 to bore hole 398) is 2,200 ft. The altitude line of 6,050 marks the floor of the pit, or proposed downward limit of steam-shovel operations as anticipated in 1912. Now, it is expected that the floor will be at the 6,000-ft. altitude level, and, as that will uncover large areas of ore underneath, it is anticipated that deeper excavation will be effected by means of inclined tracks —that is, the floor will become a slope, along which hoisting operations in balance will serve to raise the output. In some places ordinary underground mining, with caving, is likely to be adopted. The maximum stripping on the Sierra orebody, as shown in Section 31, is 152 ft. The general ratio of stripping to ore

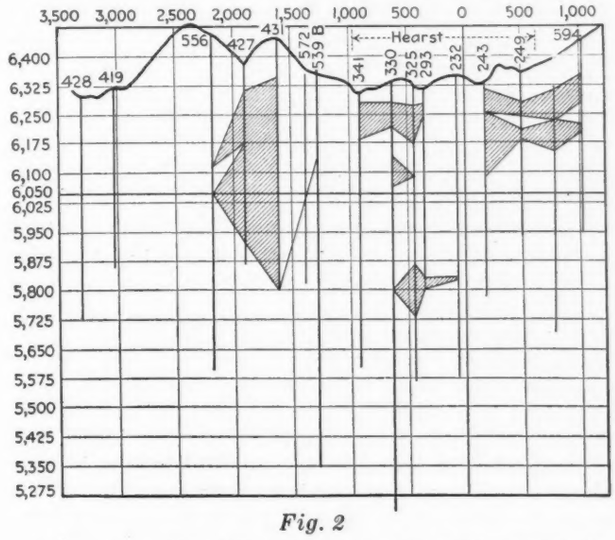


Fig. 2

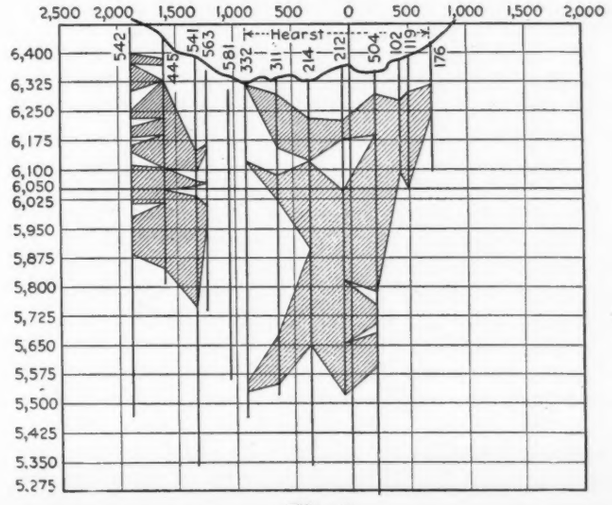


Fig. 3

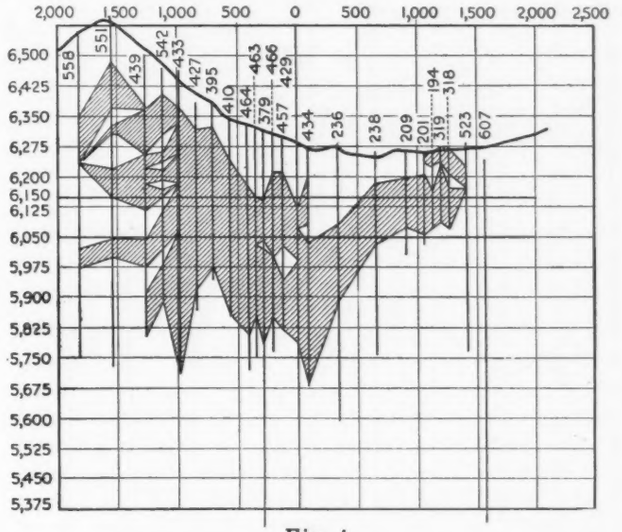


Fig. 4

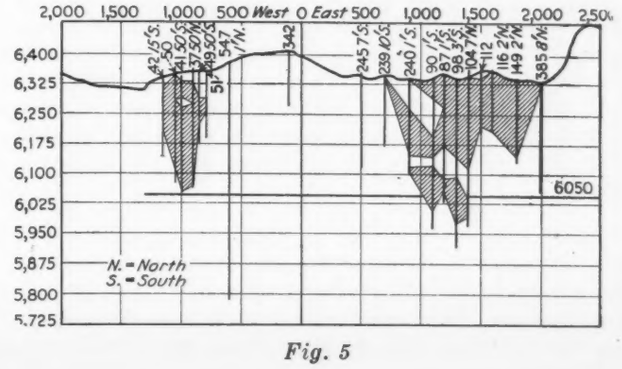


Fig. 5

for the mine is 1 ton of ore to 1.36 tons of waste, down to the 6,050 level, but including the ground to 5,900 (two benches deeper) the ratio of ore to waste will be 1:1.15.

Overburden Comparatively Thin

Details have been omitted from the other sections. In Fig. 2, the Sierra orebody appears longer; it extends from 98 ft. below the surface to a depth of 640 ft.—that is, for a vertical extent of 542 ft. The ore is outlined by drill holes 556, 427, and 431. Here the south end of the orebody seems to be indicated by drill hole 556, and No. 431 shows a face that suggests the maximum vertical extension of the ore, but no allowance is made for this obvious extension, because the next drill hole is No. 572, which is 240 ft. north (or just 40 ft. too far to be used in the estimate). Proceeding northward, we come to the south prong of the Hearst orebody as outlined by drill holes 341, 330, 325, 293, and 232. The top of the ore is 33 ft. below the surface; the bottom of it cannot be ascertained easily. The bores show extension to a depth of 587 ft., although in estimating it was necessary to assume discontinuity, because the drill holes went through poor ground. The ore cut by No. 330 between 336 ft. and 391 ft. indicates the probable vertical continuity of the orebody to nearly 600 ft., as shown in drill hole 325. An extension northward is shown by drill hole 232, foreshadowing the union of this part of the orebody with the north prong on a line at right angles to the section. Going north we come to the north prong in drill hole 243, and this orebody is cut also by drill holes 249, 584, and 594. Ore is cut first at 16 ft. below the surface, and extends to a depth of 238 ft., as shown by drill hole 243. The blanket of barren rock above the orebodies in the gulch is the result of erosion, but most of it carries some copper—for example, drill hole 243 was started in a dump. It will be noted that drill hole 232 was in rich ore between 692 ft. and 770 ft. below the surface. No. 584 also went through 51 ft. of ore at 342 ft. below the surface.

John M. Sully and Horace Moses

Coming to Section 39 (Fig. 3), we see that the Sierra orebody countinues to 642 ft. below the surface. The ore is proved by four drill holes. No. 542 shows ore for a vertical extent of 515 ft., with five intervals that are excluded from the estimate of ore in reserve. Another more to the south evidently would add considerably to the tonnage that could be estimated; indeed, the ore ought to extend for a distance equal to at least two of the 200-ft. drill-hole intervals. In this section the Hearst orebody is one, the two prongs having united. Ore extends from the surface, at drill hole 382, for a depth of 782 ft., as shown in drill holes 332 and 212. At the north end the orebody is extending under the hill, and probably will be mined some day by ordinary stoping and caving methods, because the depth of overburden is too much for economical steam shoveling. From the evidence given in this section it is obvious that at the 6,050 altitude line there will be continuous ore for a horizontal distance of about 3,000 ft., with probably a barren interval of only 350 ft.

Sierra and Northwest Orebodies Unite

In order to see the maximum extent of the ore along a cross-section at right angles through the center of an orebody, let us look at Section 26 (Fig. 4). It shows ore between drill holes 558 and 523, a horizontal distance of 3,200 ft., but as there are faces of ore at both ends it is safe to say that excavations will extend for a total length of fully 3,650 ft. This section shows the union of the Sierra and the Northwest orebodies, but none of the Hearst orebody. The ore reaches the surface at the northwestern end, at drill holes 318 and 319. On the 6,050-ft. altitude level, the ore extends continuously for a distance of 2,900 ft.

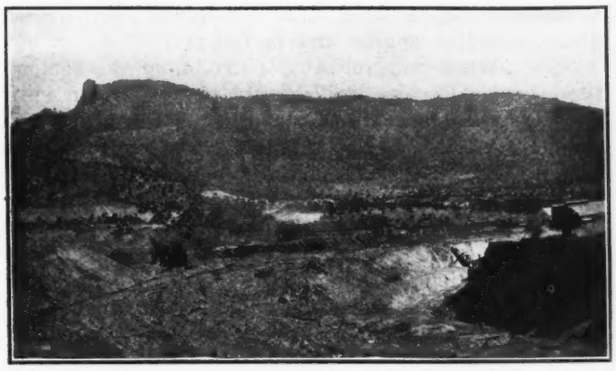
Another section (Fig. 5) shows the orebodies at the north-west end of the mine, where the ore outcropped. This shows the northwest and the north orebodies; together with the drill holes that proved them. The Northwest orebody is 350 ft. long at the surface, and has been traced to a depth of 290 ft. The North orebody shows on surface for a distance of 1,100 ft., and has been traced to a depth of 355 ft.

The drill holes ranged in diameter from 4 to 13 in., in accordance with the depth of the hole and the character of the ground. That is why promising holes had to be stopped. The drills employed were Cyclone No. 4 and No. 6; also a special drill for the 1,635-ft. hole. The others were of the standard type, such as are used in prospecting for oil. At one time ten rigs were at work; they were grouped in twos and threes for convenience of water supply and sampling. Each group had a man who attended to the sampling of the sludge; he was provided with a drier and a sample cutter, as is described in detail by Messrs. MacDonald and Enzian in Bulletin 107, to which reference has been made previously.

The small depth of the ore-bearing rock as compared with its extent favored exploratory work by means of the churn drill, and likewise favored the adoption of an open-cast or quarry system of mining.

Steam Shovel Idea Came From Alabama

The idea of using the steam shovel was suggested by Mr. Sully, who had been superintendent of the Woodstock Iron Works, in Alabama, and had seen the steam shovel applied to the mining of hematite ore in that state. At first he and Mr. Burrage had intended to employ the steam shovel for stripping and open-cut mining only on the Chino and Romero orebodies, or about half the ore-bearing ground as then known. After Mr. Sully's visit to the Utah Copper mine in November, 1908, he decided that he could give a wider application to the steam shovel, and he extended his plan of operations accordingly. In starting the "pit,"



The mine as it looked when steam-shovel operations were started

or quarry, that now constitutes the Chino mine, the first step was to strip the overburden for a width of 25 ft. and then to remove the ground underneath in a series of benches or terraces about 100 ft. wide. The height of these benches at first was only 30 ft.; now 50 ft. is found more expedient. This phase of the work has been well described by Messrs. MacDonald and Enzian:

Determination of Height of Benches

"There were three factors that regulated the height of each bench: (1) If a bank stood fairly steep for some time and then caved, it was found best to have the bench not more than 30 ft. high. The caving of 30-ft. banks caused little delay or damage to the shovels working below them, whereas the caving of higher banks often caused serious trouble. Where a bank caved slowly and kept gradually coming to the shovel at about the same general slope, it could be worked in benches of 100 ft. or more if necessary. (2) If the waste material on top of the ore was, say, only 15 ft. thick, then, of course, the bench at that place was only 15 ft. high. On the other hand, if the overburden was only, say, one or 2 ft. thick, it was probably found cheaper to let it go with the ore without stripping. (3) Where the drill holes indicated considerable relatively barren rock between upper and lower ore masses, then, as far as possible, the benches were planned so that the top ore was taken off the waste rock in one cut or bench, and the waste rock off the lower ore in the second bench, and the lower ore taken out clean in a third bench. If the orebodies and waste mass were thick enough, they were generally taken out in two or more separate benches. Barren areas of considerable size were also considered in planning the benches. In other words, the benches and tracks were planned to conform, as nearly as practicable, to the shape of the orebody, so that ore could be separated from waste as economically as possible."

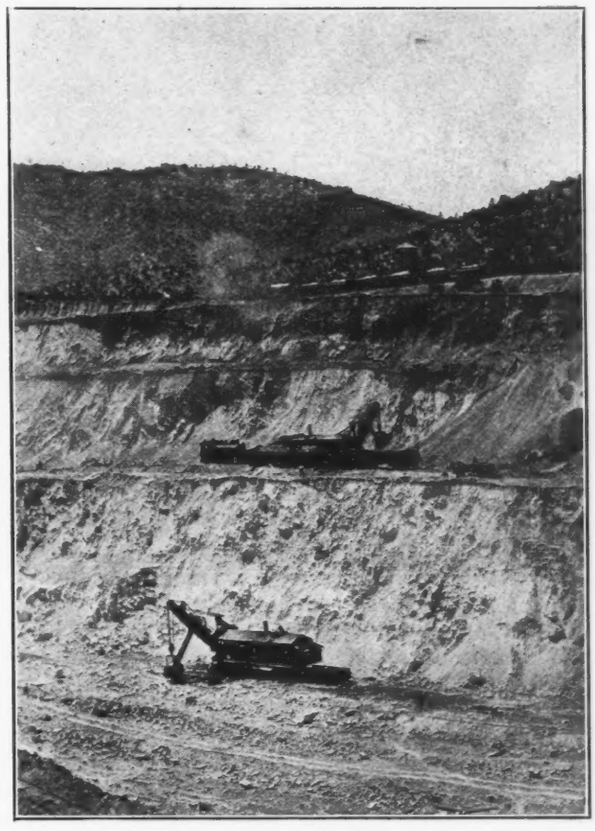
For example, Mr. Sully told me of a fault on the south side of the Hearst pit where "running" ground, or ground that caved continually, 100 ft. wide, was cut in the course of steam shoveling. The shovel was able to excavate 8,000 cu.yd. before it had to be moved forward. No blasting was done and the shovel had to be retreated three rail lengths, or 18 ft., each time, when digging into this shattered rock, which was "ore," for it averaged 2 to 2½ per cent copper.

The first bench of the Chino mine was started at a point 6,340 ft. above sea level. It happens that the first bench of the Utah Copper mine was started at 6,341 ft., and the first of the Nevada Consolidated at 6,300 ft., a coincidence from which a maker of generalizations might argue that copper ore is to be found by following a special contour line across the continent!

At the east end of the South orebody I saw a face that showed fully 200 ft. thick of barren rock covering rich sulphide ore, which extended north-eastward under this overburden of waste. Some day this ore will be worked by the caving method, for the overburden is too thick to render stripping practicable. In various other parts of the mine, for example, under Gold Hill, into which the Sierra orebody extends, and under the ridge into which the north-eastern portion of the Hearst orebody reaches, the overburden is so thick that it will be necessary to remove the ore by underground operations.

One result of the study made by Messrs. MacDonald and Enzian was an increase in the angle of the slope along the rim of the pit. The first cut was on a slope of ¾:1; below that a bench 25 ft. wide is left at vertical intervals of 100 ft., which gives an average slope of 1:1, or 45 deg. Variations are made in accordance with the character of the rock. The benches, of course, serve to stop any falling rock from reaching to the bottom of the pit.

In planning future operations and in estimating the reserves of ore, it was necessary to decide to what



The Hearst steam-shovel pit in 1915

depth the steam-shovel operations could be continued. It was decided that 6,050 ft. above sea level would be the limitation to mining in open pits, because below that depth—300 ft. below the surface—the pit would be so restricted as to necessitate a modification of the mining method. The horizontal extent of the orebodies in relation to their vertical extent will determine whether enough elbow room will be available for the

operation of the shovels and trains, and economical haulage on the railroad tracks will be limited by the steepness of the gradients. If the ore persists, especially if it continues to be rich, it may prove economical even to use rack-geared locomotives or inclined cableways. Since the first plans were outlined it has become evident that limitation to the 6,050-ft. level was conservative. If Santa Rita Creek and its freshets did not intervene, it would be convenient to extend the pit in a wider circle and adopt a circular system of railroad tracks.

Large Pump Station Required in Pit

A sump is maintained in the pit to catch the rainfall, and a pump having a capacity of 2,500 gal. per minute is available. The biggest flood as yet recorded gave

Preparations for block-holing

2,250 cu.ft. of water per minute at its maximum violence, this being equivalent to 16,830 gal. per minute!

At the south-east end of the big dump of waste are two "ore" dumps—that is, piles of "near ore," oxidized and siliceous rock containing too little copper to be treated today, but likely to come within the economic limit in the not too distant future. This shows prevision, like the impounding of the tailing from the mill. Under the waste dump a series of drill holes, 400 ft. apart, was sunk to make sure that the dumps did not blanket probable ore-bearing ground. This is another example of sagacious prevision.

The breaking of the rock—ore and waste—is done by drilling and blasting. The drills are of various types for various duties. The Cyclone churn drill is of the same design as that used in prospecting, but smaller; it is called a "blast-hole" drill to distinguish it from its big brother. The drill is equipped with an 18-hp. gasoline engine and is self-propelling, on steel wheels. When working at the maximum the company used twelve Cyclone drills, employing fourteen shifts with fourteen separate crews. Now five of these drills are in use, all on the day shift. The Sullivan 3¼-in. piston drill and the Waugh turbo-hammer drill are employed now to the extent of a total of five shifts per day, as against eighteen when mining at full capacity. These drills use 1¼-in. steel, but each type demands its own particular shank. Moreover, the turbo drill requires hollow steel. Each drill has two men on it; the helper prepares for the next hole while the machine man is drilling. These piston and hammer drills are used for making the shallow holes, down to 20 ft. The churn drills penetrate from 15 to 90 ft., according to the character of the bank, the maximum depth having been as much as 125 ft. They are employed to make the top of the bank safe by cutting it down to the required slope, whereas the other drills are used to break the bottom of the bank or bench. For this information, I am indebted to the superintendent of the mine, Harry A. Thorne (Haddon Institute, 1899).

Various Kinds of Drills Are Used

For block holing it is customary to use the Clipper hammer drill, with 1-in. steel. Not more than 4 ft. is drilled with these. Thirty of them are kept on hand, but days may pass without using any of them, and at other times three or four of them may be employed all day. Two are kept at each shovel. Any rock more than 6 ft. in maximum dimension is blasted, or "block holed," because the car doors will not allow anything larger to pass. A Dreadnaught drill, using 1¼-in. steel, is used for drilling any hole more than 4 ft. Six of these are on hand. Further, the blasting of big pieces is effected by "dobing," a term derived from the Mexican word *abobe*, meaning clay. A stick (or more) of dynamite is stuck in a dab of clay on the rock that is to be shattered. At the time of my visit five drillers and five helpers were available for each type of drill, so that ten crews of two men were at work, as against thirty-two crews, or sixty-four men, during the period of maximum production. Now 4,000 tons of ore is being broken, as against 10,000 to 12,000 in 1918.

The track men consist of three crews of ten each, as against 132 track men in 1918. The surface labor in the pits includes two (as against ten at maximum) track cleaners, four (as against six) engine coalers at the chutes, three pump men, two switch tenders (as against twelve), three teamsters (against twelve), five powder men (against twenty), and four gagers or track walkers (against six). Three centrifugal pumps, electric-driven, are in use. Two have a capacity of 1,200 gal. per minute apiece and the other has a capacity of 500 gal.

The explosives employed include black pellet powder for soft ground, Trojan bag powder (it comes in bags), a white nitro-starch powder for all kinds of hard ground except where it is wet, and Red Cross, a Dupont gelatine in sticks of 1¼x8 in. The Trojan and the black powder are used only in churn-drill holes, except where the ground is wet, when the dynamite is substituted. In the hole made by the piston and hammer drills it is customary to use an explosive called the Chino special, an ammonia powder made at Louvier, in Colorado, by the Dupont company. This is used in dry holes, whereas in wet ground the Red Cross

dynamite is preferable because the Chino special is partly soluble in water.

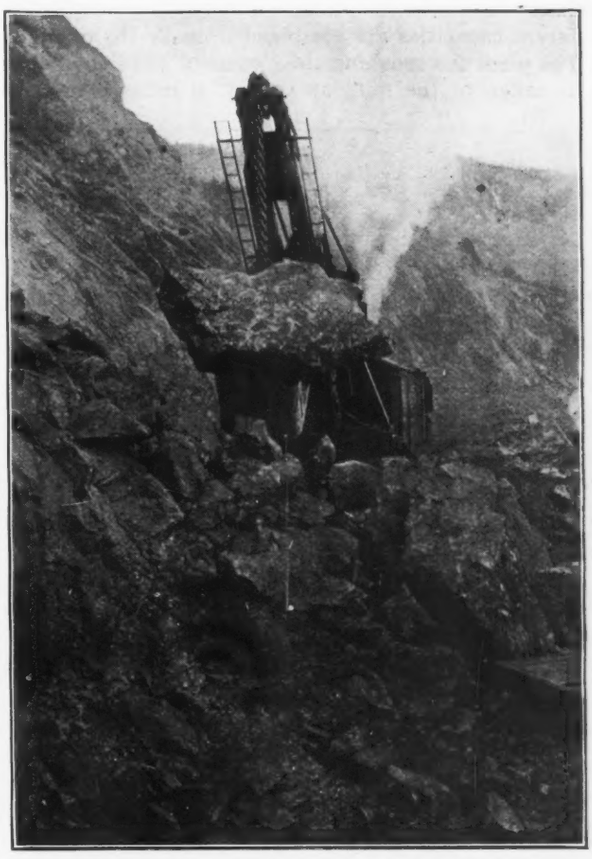
At the time of my visit four steam shovels were at work. The shovels are the Marion models 91, 92 and 100, these numbers indicating the horsepower of the hoist engine. Each shovel has three engines, for example:

Purpose	Horsepower	Cylinder, Inches
For hoisting	100	13x18
For swinging	30	9x10
For booming	15	9x10

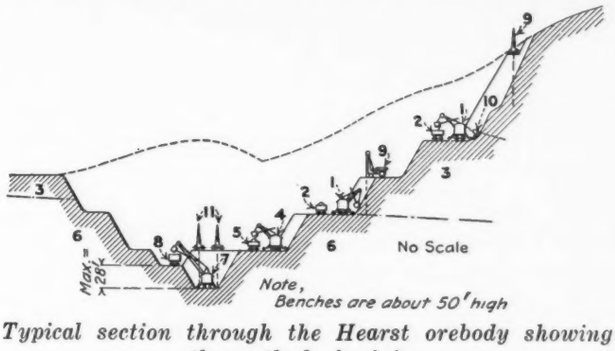
The operations are divisible into three motions: the hoisting includes the actual digging and filling of the dipper, or shovel; the swinging is the movement of the boom or crane to the face of ore and back to the car into which the ore is dropped; the booming is the advance and retirement of the dipper at the face. The cost of a steam shovel at the time of my visit, last year, was $15,000 to $18,000 delivered, but the first shovels in 1910 cost only $8,000 to $9,000. Mechanical improvements have been made at the mine, so that breakages are fewer, but there remains scope for betterment, especially in the boiler. The front end of the boiler is so short, from the front sheet to the doors, that it is easily burned, on account of the tremendous draft created by the exhaust, which goes through the smokestack. The boom engine is the only one of the three that exhausts through a pipe, which runs to the end of the boom.

When working the mine at the maximum capacity, of 12,000 tons per day, the company employed fifteen steam shovels, of which nine were operated by day and six by night. Of these, six shovels would be digging ore during the two shifts into which the working day is divided. Each shift is eight hours, one from 7 a.m. to 3:30 p.m., the other from 7 p.m. to 3:30 a.m. The capacity of a single shovel per shift is 1,000 cu.yd. of ground in place, equivalent to 2,000 tons of broken rock. Each shovel has a crew of nine men, four of whom are on the machine and five on the ground. Those on the shovel consist of an engineer, a crane man, a fireman, and an oiler. Those on the ground are the pit men, who lay the track, keep it clear, extend the water pipe to the shovel, and transfer coal from a car that stands on the track behind the shovel.

The work at each shovel face is checked by grab sampling every carload of ore. A sample weighs 100 to 150 lb. per train of four to seven cars. At the end of every shift the working face is sampled by taking some of the loose stuff at the bottom of the slope. One man is assigned as sampler to each ore shovel, and there is a man whose duty it is to sample all the waste-shovel ground.



Steam shovel lifting a piece of ore weighing many tons



Typical section through the Hearst orebody showing the method of mining

1. Steam shovel loading waste.
2. Dump train hauling waste to dumps.
3. Waste to be removed.
4. Steam shovel loading ore.
5. Dump train hauling ore to crusher.
6. Orebodies.
7. Special S.S. making the initial cut (loading ore).
8. A., T. & S. F. 50-ton ore cars.
9. Gasoline churn drills drilling bank blast holes in waste.
10. Air drills drilling toe-holes and lifters.
11. Gasoline churn drills drilling bank blast holes in ore.

Dotted line: Original ground line.
Dot-and-dash line: Approximate line between ore and waste.

Note—Ore containing large rock is loaded in dump cars and hauled to the crusher. Ore containing rocks not larger than 12 in. is loaded direct in A., T. & S. F. ore cars and hauled to the mill at Hurley.

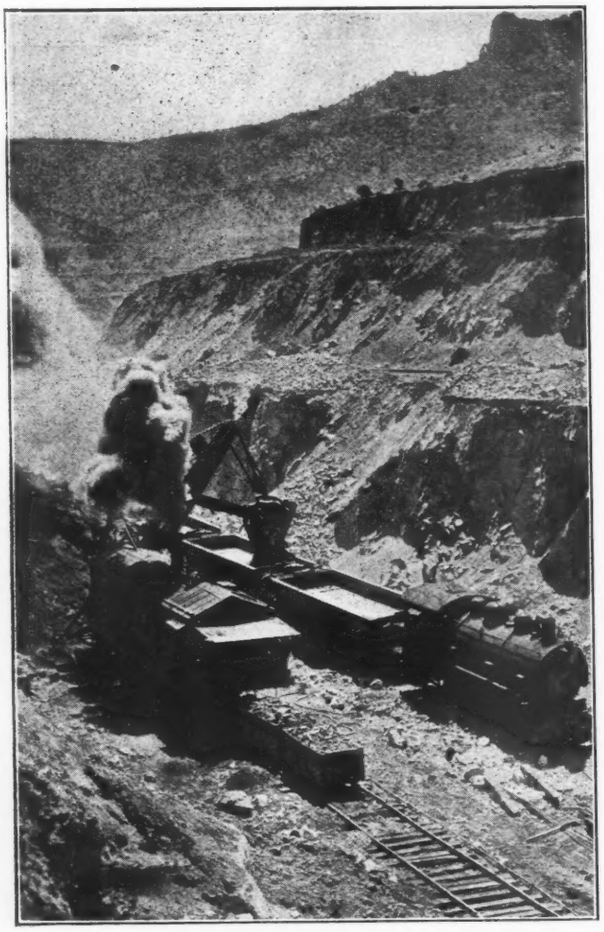
During intervals of idleness a fireman attends to the shovel and to two locomotives; he maintains steam and keeps things in good order and condition. This obviates the need for taking the engines to the shop and back again.

The cost of operating a steam shovel, including the dumping and crushing, is $11,000 per month for 23,000 tons. When starting, 15c. per ton was the actual cost. Not enough allowance was made for the expense of stripping before shoveling. In 1921 the material moved amounted to 35,900 cu.yd. per shovel per month at a cost of $17,435, of which $8,102 was expended in moving ore and $9,333 in moving waste. This included the expenses of drilling, blasting, transportation, and crushing, but not haulage to the mill.

Nine trains are engaged in removing waste and ore, according to the supply of each. On the day that these notes were collected (May 23, 1922) two shovels were working in ore and two in waste. At the period of maximum output there were twenty-seven engines, of which twenty-four were pulling trains, with three spares. Cars of two sizes, 12- and 20-cu.yd. respectively, are used. From 1910 to 1915 cars of only

6-cu.yd. capacity were in use, and some of them can be seen derelict on the high line in the northeastern part of the mine. The size of car is proportioned to the locomotive; the big engines (21x26 in. cylinder) are given seven of the 20-yd. cars, this constituting a full train. The intermediate locomotives (16x24) are given a train of 80 cu.yd. and the small ones (15x24) are allotted a total of only 72 yd. Cars of different capacities are combined to make the quota.

The plant for crushing the output of the mine before it is taken to the mill, at Hurley, 9 miles distant, is



Loading in the Sierra pit

1½ miles below the main workings. Railroad cars discharge onto a grizzly built of I-beams covered with manganese steel and 8 in. apart. The undersize drops into the bin; the oversize slides into the hopper of the crushers, of which there are two. The first crusher to be used was a 48x60 in. jaw-breaker of the Blake type, which proved hardly powerful enough to reduce the big pieces of ore, so the second crusher, 66x84 in., was added. This one crushes to 8 in., or small enough to assure the passage of the ore through the 12x13-in. openings of the grizzlies at the mill. The older crusher is used now only in an emergency, and to reduce the carbonate ore from Lee Hill.

The weight of the crusher is 475,000 lb. The play between the jaws is 3¼ in. The shaft operating the pitman makes 80 r.p.m. A set of railroad ties serves as a cushion to protect the concrete abutment, at the back of the crushers, from the violent impact of the descending ore. Likewise, steel chains are hung above the jaws of the crushers, to protect them from excessive violence. Above each crusher a plate of manganese steel serves to check the impact of the ore and to prevent arching.

The ore drops from the crushers onto steel pan conveyors, the larger crusher delivering to a conveyor 5 in. wide and the smaller to one 4 in. wide. These move the crushed ore up a 15-deg. incline to the loading bin, which has a capacity of 567 tons. It is 40 ft. long, 14½ ft. at the base, and 23 ft. high. Six chutes on each side enable two railroad cars to be loaded simultaneously. A car of 50 tons' capacity is loaded in about fifteen minutes. At first a gate was placed at the bottom of the bin chute in the old, or No. 1, plant, but the effect of it was to build a column of ore and thereby to check delivery. Above the gate leading from the lower, or fine ore, bin there are louvers to permit a man to poke the ore with a crowbar or to introduce a stick of dynamite, when the formation of an arch makes it necessary to loosen the packed ore by decisive methods.

The total cost of the plant was $127,000, of which $42,000 was for labor and $85,000 for equipment. The cost of operation is 1.25c. per ton of dry ore.

Work Now on Curtailed Scale

All the unskilled labor in the pit is done by Mexicans. The shovel and train crews are "Americans", which includes a few British and Canadians. Besides the pit crews there are those on the dumps: eight men and a boss on each dump, two of which were busy at the time of my visit. As many as seven dumps, with fifty-six men, have been maintained in activity during the busiest times. The men are not unionized—that is, the Chino mine is worked on the basis of the open shop. In 1914 common labor was paid $2 per shift, now $2.10; the machine men or drillers received $3.25 in 1914, now $3.50; the shovel engineers were paid $190 per month in 1914, now $6.50 per shift, or $199 per month for full time; the churn drillers were paid $5 in 1914 and $4.75 now, because eight years ago they operated the bigger, or prospecting, machines. In 1919 common labor received $3.65, the drillers $5.25, per shift, and the shovel engineers $250 per month.

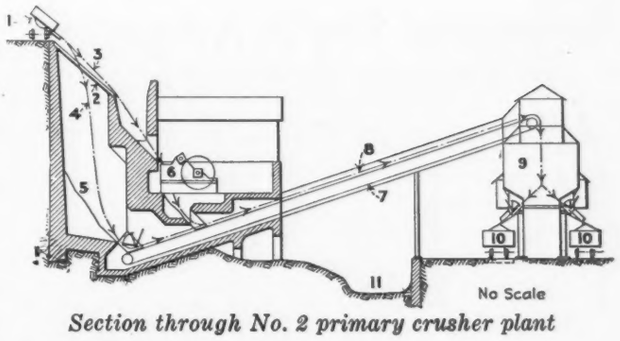
The practice of paying the men on the sliding scale based upon the price of copper, which practice was adopted when the price of copper began to rise rapidly during the Great War, is not commendable. The adjustment failed because the men refused to abide by it when the price of copper declined. Moreover, the price at which the company sold its copper could not be ascertained always at the time when a man was being paid his wages. In 1912 the shovel engineers asked for $190 per month when they were receiving $175, although union wages at the time were equivalent to $150 per month. They "walked out," or ceased work, over-night. This they did as individuals; it was not a unionized gesture of protest. It was not a strike. There have been no labor troubles since then. The company used to maintain a bunk house and a boarding house until the shutdown in April, 1921, for the benefit of such of its employees as cared to avail themselves of these conveniences. The charge was $8 per month for a single-bedded room and $10 for a double-bedded room, and $35 per month for board. Of the single men on the payroll 70 per cent took advantage of one or the other of these facilities, and the majority took both the board and the lodging. It is advisable always not to force

the men to use a company's boarding house. The men at the Chino are not compelled even to use the company's store, an institution that at other mines has been the cause of much bad feeling, when the men are obliged to trade there. At one time the company had as many as 1,200 men on its payroll, and yet had no trouble with any of them, because it is a rule that any man can appeal to any member of the staff up to the manager.

The company maintains a club house, which is open to the people of the town as well as to the company's employees, and all pay the same dues, of $1 per month. The company provides the building and equipment, and those who use it meet the expense of running the club house. A hospital is maintained by the company. Married men pay $1.75 per month and single men $1.50, but these contributions do not suffice to meet the expense, so the company pays the deficit. At Hurley, where the mill is, the company maintains another club house; the building, furniture, and other equipment were given by the company, which also provides water and light. The members pay dues at the rate of $1 per month. There is a dormitory and mess house for members of the staff, and a house for the other male employees.

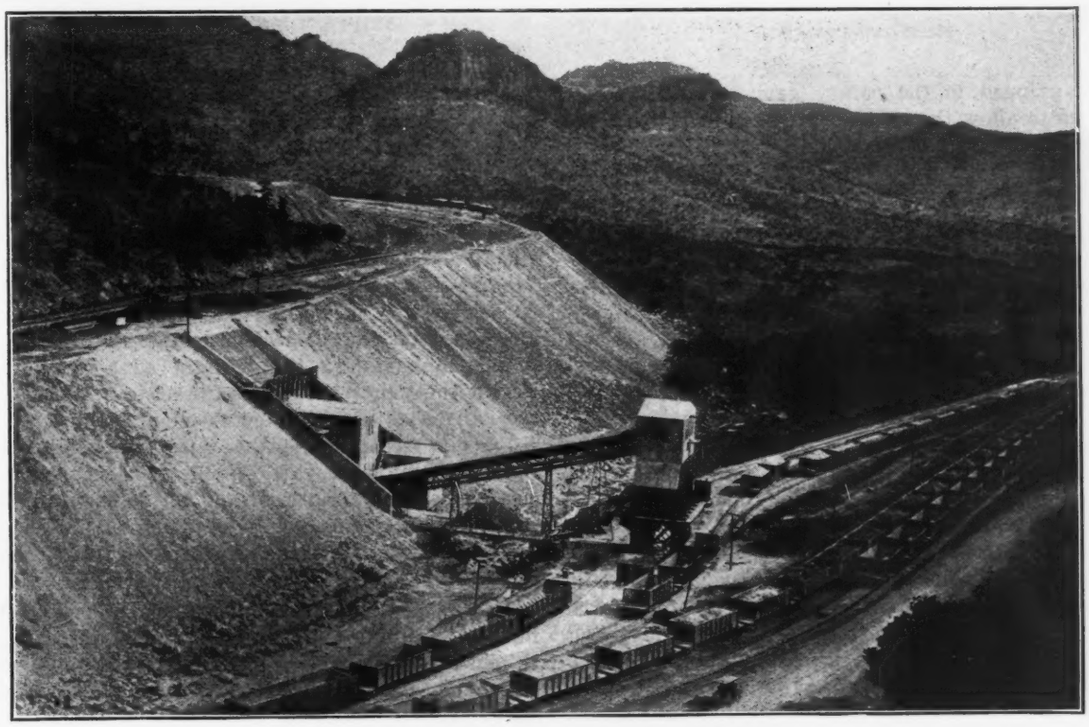
Some of the notorious Mexican *revoltosos* worked at Santa Rita, notably Inez Salazar and Manuel Orosco. Both of them had leases on the Chino property and also worked as miners for the company. Fidel Barrios, paymaster of Pancho Villa's army, came to Santa Rita in 1918 and gave a big dinner and dance to his compatriots. He had worked as a miner for many years in the Chino. Later it became known that his hospitalities were paid in money he had stolen, for some of Villa's men came to Santa Rita in pursuit. It must be remembered that the Mexican border, at Columbus, is only 70 miles distant. No indigenous Indians are working in the mine, but half a dozen Yaquis from Mexico were employed until a year ago. They were "dandy workers," says Mr. Thorne. Most of the Mexican employees were natives of New Mexico in the days antedating the introduction of the steam shovel. As soon as that machine was introduced the company had to secure a larger supply of labor, and obtained part of it from old Mexico. These were called *zuramates* (hoboes) and *pillaos* (slaves) by the New Mexican Mexicans, with whom they did not assimilate, and who, stimulated by visits to the saloons, attacked the gentlemen from the southern side of the Rio Grande and tried to drive them out of town. When, however, the proportion of old Mexicans increased as against the New Mexicans, the latter found it wise to acquiesce in their presence at Santa Rita.

To be concluded.



Section through No. 2 primary crusher plant

1. Dump train arriving from shovel with ore.
2. Grizzly with 8-in. openings.
3. Oversize.
4. Undersize.
5. Fine ore bins, capacity about 1,500 tons.
6. 84 in. x 66 in. Blake jaw crusher, 80 r.p.m.
7. Two 5-ft. steel pan conveyors; speed, 60 f.p.m.
8. Ore crushed to 8 in.
9. Loading bins, capacity approximately 1,450 tons.
10. A., T. & S. F. 50-ton ore cars being loaded with ore.
11. Santa Rita Creek bed.



Trains of ore at No. 2 crushing plant

Measuring Depth Accurately in Rotary Well Drilling

How to Determine Thickness of Strata and Other Data for Recording in Log

By Albert G. Wolf
Mining Engineer, Gulf, Texas

THE ROTARY METHOD of drilling is one that readily lends itself to the accurate determination of well depth at all times. In the majority of operations, however, full use is not made of this advantage. To attain the highest degree of precision at all times is no more difficult than to do slipshod work, with results only approximately accurate; but to do so the method must be right, the drilling crew must be accurately trained, correct measuring instruments must be provided, and the records of the work must be properly kept.

In this method of drilling, the hole is made by the rotation of a specially shaped bit on the end of a string of pipe called the "drill stem." The stem is revolved by a "rotary" in the center of the derrick floor. Usually the top joint of the string is a heavy "grief stem,"

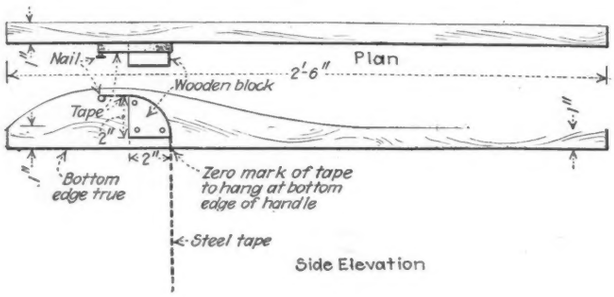


Fig. 1—Tape handle of wood for measuring drill stem and casing

which is gripped in the rotary gear table in such a manner as to allow the entire string of drill pipe to be raised or lowered while rotating.

Inaccuracies in Depth Measurement

When drilling has progressed to a point where the top of the grief stem is level with the rotary table, it is necessary to add another joint of stem. Drilling is stopped, the string of pipe is raised until the top of the uppermost joint of drill stem has cleared the rotary table, the grief stem with swivel attached is then unscrewed and set aside, and a new joint of stem is swung into place.

It is in the measuring of the lengths of these joints of drill stem and in the recording of their lengths that errors creep into the well log. Sometimes a cloth tape or "metallic" cloth tape, which, if old, is sure to have considerable "stretch" in it, is used; carelessness is displayed in the measuring; frequently the joint is measured from the end of the collar to the top of the threads, and when the piece is screwed onto the string it "makes up" shorter than its estimated length; the end of the tape is often used as the zero point when the mark may be three-tenths of a foot farther along, and often, when a steel tape is provided, an end is broken off, and proper allowance for the deficiency is not made. These, or many of them, are minor matters, one may say, and do not amount to much. But the small error may be cumulative, and then it will amount to considerable in a 3,000- or 4,000-ft. hole.

In any field where a number of wells are to be drilled the elevation of both the rotary table and the ground at each well should be determined accurately by leveling from the nearest bench mark. The driller, in logging his well, should give all the measurements from the rotary table; but in recording these reports in the office, the depths should be transposed to read with reference to a fixed datum plane and should be recorded to the nearest one-tenth of a foot. In the Gulf Coastal fields, where the surface elevations are all quite low, sea level is by far the most convenient datum. If all permanent records are entered with reference to this plane, using the minus sign for depths below sea level, the logs of various wells can be far more intelligibly and readily compared than if the depths are given from the rotary or ground, starting at a zero depth. The rougher the topography the greater the advantage in this method of recording.

The driller ordinarily keeps track of the thicknesses of the strata through which he is drilling by noting the mark on the grief stem at the top of the rotary table when entering a stratum and when leaving, or entering the next lower, and by measuring the lengths of drill stem added, if the stratum is thicker than the length of the grief stem. These data are carried in a pocket note book, and, at the end of the shift, are recorded on a printed form provided for the purpose—that is to say, they should be so recorded.

Frequently, the measurement of each length of drill stem is taken from the top of collar to the top of threads while the joint is lying on the ground. This is wrong. The length should not be measured until the joint is screwed up on the string, and then the measurement should be taken from top of collar to top of collar. To insure accuracy, a steel tape, graduated to feet, tenths, and hundredths, should be used, and to aid the derrick man, a convenient handle for the tape should be provided. Such a handle is shown in Fig. 1. It is of wood and of convenient length, say two or three feet, and with a straight bottom edge. On one side is nailed a piece of wood, thicker than the width of the tape, and shaped like the quarter segment of a circle. The tape is laid over the curved surface of this piece, and fastened by a nail driven through the tape ring at such a point that the zero graduation of the tape is held exactly at the bottom of the handle. In measuring a joint, the derrick man grasps the stick by the small end and lays the straight edge of the big end across the top of the collar or tool-joint of the piece of pipe that has been just screwed into place. (See Fig. 2.) The driller pulls the tape taut, and reads the length of joint to the top of the next collar to the nearest one-hundredth of a foot. The tape is then easily swung aside into the recess of one of the derrick legs, where it is effectually protected until it is needed again.

It may be argued that measuring and recording the lengths of joints to the nearest one-hundredth and the thicknesses of strata to the nearest one-tenth of a foot is needless accuracy. So far as a driller being able to determine the limits of a stratum within that distance is concerned, the objection is quite true; but a driller trained to make the measurements as outlined

gains the habit of accuracy that is attained in no other way. If the thicknesses of strata are recorded to the nearest foot only, and pipe lengths to the nearest inch, as is usually done, a slovenliness results in all the records that often leads to greater inaccuracies. The use of tenths and hundredths of a foot instead of inches is preferable as less arithmetic is required in totaling columns of figures.

At the end of a shift (tour) all the driller's records are written on a printed form which is transferred to the company office, and which is the chief source of information in making up the office record of the well log. It is evident, then, that great care should be taken in making this field record, and that a check on the driller should be employed. Rarely is this done. On account of the importance of the field record the heading shown in Fig. 3 is strongly recommended by me for this field blank, for it provides a check on the driller's depth measurements.

In the first line of the right-hand column is shown the length of drill stem reported at the end of the previous shift, and which showed on the report of that shift in line No. 3 of this column. This includes the total length of drill stem, kelly joint, bit, and drill collar. Next below is shown the net result of all drill-pipe changes during the shift, with an indication of whether added or removed. In line 3 is shown the result of adding line 2 to line 1, or subtracting, as the case may be. In line 4 is then shown the length of the grief stem (kelly joint) above the rotary table, and then, by subtracting 4 from 3, is shown the depth of the hole in feet and hundredths as measured from the rotary table.

In line 1 of the left-hand column is shown the depth of the hole as reported at the end of the previous shift. In line 2 is shown the amount drilled during the shift being recorded. This is the sum total of the thicknesses of the various strata penetrated; these strata and their measurements being recorded individually in the lines provided below the double-column heading. (The complete blank, of course, provides spaces for recording the date; location of well; formations penetrated; remarks as to delays, or any special work, such as setting casing; name of driller and names of helpers). Line 2 added to line 1 gives the depth of the hole at the end of the shift, which should check exactly with the figure given in line five of the right-hand column.

The right-hand column naturally governs the depth of the hole if a discrepancy exists between the results of the two columns, yet it is this column that is not shown on the majority of report blanks in general use. The big advantage of this form is that no mistake can go undetected beyond the shift, and the correction can be applied at once to the stratum of least consequence. The usual form of report blank employs only the left-hand column, shown here, for recording the well depth, and a mistake or series of mistakes will run on unheeded unless the well depth is checked by running a steel line, or by measuring the entire length of drill stem while going into or coming out of the hole. Even then the mistake or series of mistakes cannot be localized, and a shadow of inaccuracy is cast over the whole log.

In setting casing, exactly the same principles can be applied as in drilling. The length of each joint of casing is measured after it is made up, and is recorded on the blank just as an individual stratum would be. An accurate record is then preserved of the lengths of the joints in their order and of the total length of the string. When the setting is completed the elevation of the top of the string is taken. The exact depth of the seat and of every coupling is then known.

Some of the advantages of making and recording all these measurements so accurately may be summarized as follows: Depths of all wells are based on the same datum plane; formations are then plotted at their true relative depths, and logs of various wells are easily correlated. All measurements are precise. This, coupled with the datum-plane method of recording,

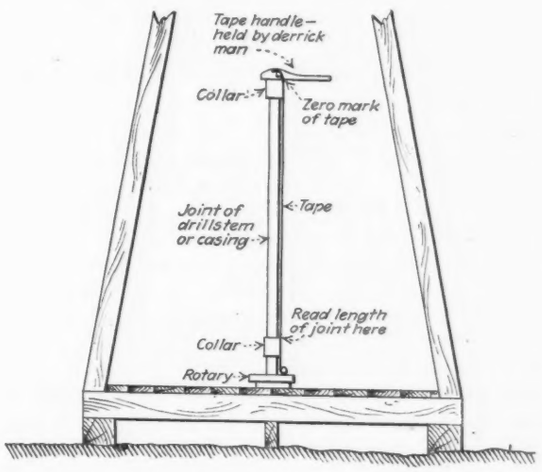


Fig. 2—Method of using tape handle in measuring drill stem and casing. Not to scale

makes it possible to drill new wells and estimate in advance just where certain sands will be encountered. While drilling, the depth of the hole is known absolutely at all times. Depths of casing seats are known exactly. Casing can be perforated at the depth desired, or can be shot off in a coupling.

Well No.....	From.....M. to.....M.
Depth previous report	Length drill stem previous report, feet
Feet drilled last shift	Changes in drill stem pipe added or removed, feet
Present depth	Present length drill stem, feet
Driller should report formation and depths correctly, also report number of hours drilling, changing bits, repairs and delays.	Drill stem above top rotary grips, feet
	Present depth, feet

No. Feet	FORMATION	Depth

Fig. 3—Part of driller's daily report form, showing double-column check heading

Further discussion of this special subject would run into operating methods and cost data. That accurate data on all well-drilling operations are desirable goes without saying, and all measurements of depth and strata thicknesses can be precisely made and accurately kept by the above-outlined method. The only inaccuracies involved are the stretch of the drill stem, about 1 ft. in 3,000 ft. and the slight "make up" in the drill steam after drilling proceeds.

DISCUSSION

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

What Has Become of the Prospector?

THE EDITOR:

Sir—I have always been a reader of the *Journal* and *Journal-Press* and other mining literature in which I am interested. I follow mining and prospecting continuously, and I have heard the question asked at times, "What has become of the prospector?" You can travel almost anywhere and meet very few men or parties that are really prospecting. I will try to tell you in a few lines what has become of some prospectors in California.

The prospector of the present day, coming into the California fields, will find himself up against a great puzzle as to how to proceed, and one reason is the handicap imposed by the requirement that a location notice and a one dollar bill will hold a claim for one year without any more being done. Who wouldn't pay one dollar to hold any kind of a showing for one year? I myself have personally located some claims, but before I had recorded them I heard of a little excitement, and of course, I went over to see what it was about, and didn't return—but my location notices are holding good. The next prospector comes along, reads my notice, and sees that the date is Aug. 1, 1923. Well, he calls the ground located, not having the time to investigate. Investigation requires not only time but money. Not many of us prospectors are overloaded with money, and so we take "Lizzie" or the burros and move on.

Recently I met a man who had been here before—possibly several years before—and when he was probably 500 miles away he remembered the ground, and having a few dollars left decided to come back and prospect it again. I don't own the ground, but these unrecorded locations are holding good. One day I met Mr. Man, who stated that he had come through from Colorado to prospect the ground, and he finds that I have a location there. I told him all about it, but without an accidental meeting I would still be holding this ground—not intentionally but because I neglected to take my notices down and had not the means of going back to do so.

There are thousands of claims that are being held from year to year, with only a notice and the payment of a dollar fee. I know of people who have been holding at least fifty claims in that way. A man locates one year; next year his son locates, then his wife, then his friend. I locate for you, you locate for me; and so on. I personally know that in the section to which I refer not a pick has been stuck in the ground for at least six years; but the ground is always located. I made three expensive trips into the district before I got hold of any claims without having a gun stuck in my face and being told "You are on my claims." As I am not looking for trouble and knowing what is done with a stranger and what happens to his outfit, I finally wound up by looking for a job. The next time you talk prospecting to me, there is nothing doing. The o' prospector is disgusted. The squatter is holding for a dollar a claim for suckers—for someone coming along to buy. But what man wants to buy something that by rights already belongs to him?

There is a group of business men in Los Angeles who run shows, hardware stores, and garages and who are holding a big group of claims, and have held them for a number of years. Every year they send a man out with a bunch of location notices already made out, and at the end of the year this party has new notices on all those monuments within four hours. I have seen this done for two years, myself. Someone who is capable and who has the prospectors at heart should take this handicap off by having the laws changed.

The situation in other states is almost as bad where claims are patented and let lie; parties owning them will not develop them nor give any reasonable lease. I say that these idle patented claims should be taxed heavily enough so as to be of some benefit to the country, or to be a burden to their owners, so that they would either have to do some good with them, or leave them alone. Then there would not be so many patents, and there would be more development by assessment work, which, in turn, would help build better roads. I do not think that the mining laws work out entirely for the good of the country or the people in general. They seem to me to favor and protect only a certain class, which really does not need this protection.

If I were capable of putting my experiences into thought and print, and before the public, I would surely stir up some battle, but I am only a prospector and miner, having followed the game for twenty-three years. If you love the prospector, at least you will expose this handicap and make a fight in your columns for a better and a squarer deal for him and for the ghost cities of our mining states which have been killed by non-producing patents and by lack of development.

Randsburg, Calif. PROSPECTOR.

The Society of Doodle-bug Operators

THE EDITOR:

Sir—Your editorial under the caption "The Doodle Bug Again" in your issue of Dec. 1 prompts me to send you the following, which is a full copy of a letter recently received:

"Dear sir Please let me know by return mail what a miners instrument will cost to locate mineral with."

It was written with a lead pencil but quite legible. I had never heard of the party before and there was no postage stamp enclosed; therefore I did not supply the desired information. VICTOR G. HILLS.

Denver, Colo.

Comment on Ball Milling

THE EDITOR:

Sir—In your issue of Dec. 1, page 951, there is a further discussion on the subject of "Shape of Grinding Media," by R. C. Neuhaus, which takes up the subject of grinding media from a little different angle.

As stated previously, our company has experimented with different types of grinding media also, and the conclusions arrived at are very nearly the same as those of Mr. Neuhaus. In speaking of the inability of a flat disk or hollow ball to crush the coarse pieces economically, it would appear from the experiments we have conducted that this is due to the fact that a large piece must be dealt a severe blow in order to break it. This blow should occur at one point; otherwise, the piece will simply chip and effective grinding will be less. Increasing the surface of the grinding media increases the chance for it to strike at two or three points, rather than one point, which would be the case using a ball. The coarse would then be distributed over the two or three points of the same particle or different particles in the same vicinity.

When fine particles are ground the difference in relative weight and sizes between the ball and particle or the disk and particle is sufficient to overcome this handicap and thereby improves the operation to some extent. To what extent the flat disk or concave ball is more efficient than the round ball it is impossible to state, as this factor is not alone dependent upon the size of ball, and relative sizes of particles, but also on the mass within the mill, for the greater the superincumbent weight the greater will be the grinding effect. We have also found in practice that the larger the diameter of mill the better mass action there is, and more effective grinding for a given power and ball consumption.

Referring also to the article by Donald H. Fairchild in your Nov. 17 issue, his deductions are borne out in practice as far as I have been able to determine. It is difficult, however, to make a small model mill and operate it the same as a mill in practice, because correct proportions are extremely difficult to secure, such as capacities, relative sizes of particles, sizes of balls, and time allowed for cascading or falling. Mr. Fairchild mentions that the results show the mass nearest the surface does the most effective work, and that the mass below moves but slightly. This slight movement, therefore, leads him to doubt the grinding effect lower down in the mill. There is no question that the greatest crushing effect is near the surface, but I believe there is also a considerable amount of grinding done within the mass itself, which is not evident at first. The movement does not have to be great. It need not be more than $\frac{1}{8}$ or $\frac{1}{4}$ in. in order to grind the fine particles. It is this slight movement within the mass which causes the fine grinding within the mill. A bucking-board (attrition) action is secured rather than a stamp (impact) action, which crushes the coarse pieces near the surface. His conclusion is that the center of the mass at position marked *C* shows there is practically no motion and in this zone there is practically no grinding. This assertion seems to be borne out in practice. A long tube mill should then have a larger dead zone than a short cylindrical or conical mill. It may be due to this, together with the fact that the load in a long tube mill is not so distributed as to allow heavy mass action, that the shorter but deeper mills built today have proved so effective. It has been demonstrated a number of times that the mesh tons per horsepower in a long tube mill are less than in the equivalent short mill without outside classification, although a short mill run without outside classification is impracticable from other standpoints, and was one of the reasons why it was never adopted until suitable classifiers were developed.

More study along the lines Mr. Fairchild and others have pursued should give us valuable information, although we must be careful in making these tests that we take into consideration all the factors possible, in order not to be deceived by apparent results which are not checked in practice under actual operating conditions.

HARLOWE HARDINGE.

New York City.

Welcome the Coming, Speed the Parting

THE EDITOR:

Sir—On page 927 of the Dec. 1 issue I read with interest your brief but to the point editorial, "The Doodle Bug Again." Inclosed you will find some clippings from the *Tonopah Times*, of many different dates, which dwell on the much-heralded radio ore, oil and gas finder, William Guest. Singular as it may seem, many are certain that Guest and his ore-finding machine will "spot" numerous Goldfield Mohawks, Sandstorms, and new bonanzas-to-be.

Technically trained engineers and field-trained prospectors must now pass into the dismal and dark shadows of unusefulness, for hail to the fellow with the radio machine which carries the kick that will upset a mule when orebodies are registered below the surface where no outcropings are in evidence.

Education and broadened experience go for naught. Pray tell me, where is the technical man so enlightened that he can foretell the exact depth at which gas will be encountered in an oil well to be; where is the engineer who can foretell at what depth the "liquid black gold" is going to gush out all over the Columbus marsh of Nevada; where is the man can foretell the exact depth at which the "pay dirt" will be struck? Yes, where is he?

Ore and oil finding has been simplified by "Bill" Guest and his ore-finding machine (?) So simple is the trick, that you merely walk along blindfolded by your imagination, with no thought of surface formations or indications of mineralization, with a strong grip on the handles of the machine. Understand the grip must be as strong as is necessary to have on a double-jack when putting down a "two-handed hole." When you feel a slight electrical tingling you are getting close. Advance to your objective and, as the tingling increases and becomes so strong that you fear you will be bowled over if you do not immediately release your grip, then you are on the "spot" beneath which are hidden orebodies of real assay value. In the event you are doodle-bugging for oil, then the greasy fluid is surely there in gushing quantities.

The beauty of the doodle-bug system is that no more fruitless location holes will be dug, in the wrong places, and that if you are a good doodle bug with a clever gift of gab, $10 a plate banquets will be given in your honor at the leading hotel of the camp in which you are doodle-bugging. Without a doubt, a mapping, cross-sectioning and automatic photostating attachment will soon be added to the radio-ore and oil-finder machine,

that will be a boon for the humble prospectors who have been praying for a sample map which would be satisfactory to submit to "the powers that be." To say the least, Guest has many guessing, while he, Guest, is an honored guest at banquets and ore- and oil-finding gatherings. J. THOMAS KEENAN.

Silver Peak, Nev.

Concerning Prospect Prices

THE EDITOR:

Sir—According to press reports, at the recent meeting of the British Columbia section of the Canadian I.M.M. at Trail, B. C., one of the members declared in a very loud voice that he had "recently returned from England, and that if British Columbia prospectors would only come down to earth, the mining districts of the province would be flooded with British capital."

It seems to have become the fashion at most mining conventions for some one, usually a certain type of "engineer" or promoter, to give vent to some such bosh as the above, for that it *is* bosh everyone acquainted with real conditions in this province knows, and if he is honest he will admit that nowhere else in the British Empire do good prospects bring as low prices as they do in British Columbia. To cite one notable instance of recent years, the Premier mine brought the prospectors who located it and demonstrated that it had the "earmarks" of a mine only $100,000 on a time bond, so that they actually received only a very small percentage of that sum before the property had been proved to be worth many millions; and the price paid for the Premier was and is away above the price usually realized by the British Columbia prospector for a fairly good prospect even after it develops successfully. Before such development what he receives is such a trifle that it would be a petty "investor" indeed whom it would debar from "investing."

Any honest person will also admit that there are at least a hundred prospects in the market awaiting development and sale for every one that is ever even bonded, but that, of course, is the condition certain parties wish to perpetuate. It also must be admitted, except by those with axes of their own to grind, that the price paid for a good prospect, even if such price was many times as high as it ever is, never yet in the whole history of mining caused the failure of a mining enterprise, nor has the low price stipulated to be paid for a poor prospect ever caused the success of the company or the individual undertaking its development. The moral of this is that the "investor" should insist on a prospect being good, no matter if he does agree to pay a good price, provided said prospect develops as it looks; and such properties are to be had in British Columbia by the bona-fide investor if he looks for them.

As for a "flood" of British capital coming into the mining sections of British Columbia, there are some prospectors still left who remember the "flood" of 1896-97, during the Rossland boom, when a vast amount of British capital was hopelessly sunk in this province, since when such capital has been shy of mining enterprises here; these prospectors remember distinctly that very very little of that golden "flood" overflowed into their pockets; most of it was secured by promoters, some of the chief ones being English at that. The balance of the "flood" was utterly wasted by so-called engineers in the attempted development of hopeless prospects, which never had anything to recommend them but the much-desired low price (which they were not worth), and which the professional prospector would not touch with a forty-foot pole, even if said pole were strongly charged with disinfectant.

I think it likely that those who bewail the high prices of good prospects must have some axe to grind, such as advertising themselves as devotedly attached to the interest of the wealthy investor but not the poor one, for it must be remembered that the prospector is comparatively the heaviest investor of all, for he invests all he has, and his life as well, but lack-a-day! he is not wealthy, and therefore, not to be considered by such people. There are no fat fees or juicy salaries coming from him, so, "kick him again" is their motto; or perhaps, they would like to do a little promoting. How pleasant it would be if those wicked prospectors who demand a square deal would only be "reasonable" and give them a valuable property for a sack of beans, some rancid bacon, an old jack-knife! They could then "turn it over" to the beloved investor for a million or so.

It may be permissible, seeing that the wailers over the high price of prospects are so free with advice to the prospector, for the prospector to point out to them that, if they are really honest and sincere in their lamentations, there is nothing in the laws of British Columbia to prevent them from repairing the situation by going out in the hills themselves, and, as prospecting appears to them such a short and royal road to wealth, finding a few good prospects, which they can present to the investor, and thus induce that golden flood to flow. In the course of twenty years or so industriously spent prospecting, they might acquire enough knowledge to find something really good; and, what is more important, they might by that time be able to recognize a really good prospect when they saw it. It is doubtful, though, if their ideas of a good prospect's value would be the same then as now. I rather think they would change materially.

There is little use, however, in giving such advice to the wailers. They are constitutionally averse to undertaking or financing anything so risky to their own pockets as prospecting; they would rather advise "George" and "let him do it" at his own expense as heretofore. They did manage to induce the British Columbia Government to finance parties of returned soldier prospectors a couple of years ago, who, directed by the District Engineers, failed to find one solitary prospect. What that little experiment cost the government has been kept discreetly silent, but the British Columbia Government, which is a pretty good sport, "funked" on more than one season of it.

Smithers, B. C. DONALD C. SIMPSON.

Who Can Answer This?

THE EDITOR:

Sir—Speaking of odd and curious mining terms, can you or any of your readers throw light on the origin of a word in somewhat frequent use among the feldspar miners in Maine? The word is baratite (spelled phonetically, as I have never seen the word in print), and it is applied to the small trap dikes which cut some of the larger bodies of pegmatite. It may be a corruption of some perfectly legitimate term, but I have never been able to dope it out. FREEMAN F. BURR.

Canton, N. Y.

Consultation

Combining Prospecting and a Mining Education

We have received the following inquiry from Idaho:

"I have three sons just big enough to go out into the hills with their daddy, who would like to interest at least one of them in the mining industry. To do this I would like to lay a foundation of practical knowledge based on scientific and technical skill. Now, we have to learn the business from the grass roots—daddy and kids alike. We would like to know something about minerals and the formation they are most frequently associated with. As we do not know much about minerology and geology, our textbooks must be not too technical but plain and understandable to the ordinary untrained lay mind. We live in a country that will afford opportunity of practical application and original research. What we want is something to guide us in our search for knowledge and information. Would you advise, for instance, that daddy take up a correspondence course in mining? If so, where is a reliable institution of that type? Or would it be better to purchase a set or series of textbooks for individual instruction? If so, what books would you advise and where may they be obtained?

"Now, suppose daddy should buy a mine (all prospects being supposed to be an embryonic mine)—a grass-roots prospect that courts further investigation such as a fairly well-defined ledge, and fair assay values of gold and silver. Now, to proceed with its practical and scientific development we need advice, direction, and help. We have the means to afford us a most enjoyable vacation each summer and would like to take the boys and go back into the hills and develop our mine. But we do not know how to drill a hole, load a hole, or shoot a hole. Do not know how to sharpen and shape a drill, frame a set of timbers, start a shaft or tunnel, yet we have the spirit to want to learn and learn it right. Where will we go for our information?

"Some one may advise us to leave mining strictly alone, others may say go to work in some mine and let them teach you. All very well, but for obvious reasons daddy needs a vacation every summer and wants to take his three boys with him, fish, hunt for fun and relaxation, and work his mine to train his boys, so we wish to do it this particular way. We do not expect to learn it all in one summer, but stretch it over a term of years. We would like to begin at the bottom and learn the business from the grass roots, as the prospector says, so will you please give us a steer. Now, there may be others in somewhat similar circumstances and if you wish you may restate this proposition in the *Journal-Press*, which we are already enjoying each week, so you need not include that in your curriculum, but it will not be necessary to publish our names."

It is rather difficult to advise you regarding the problem outlined, and if you consulted other quarters for counsel you probably would obtain entirely different advice. Practical mining cannot be taught from textbooks. However, you may obtain much valuable and interesting information regarding minerals and geology from perusal and study of good books on these subjects. We would suggest, for instance, that you procure a copy of a book called "Mineralogy," by Kraus and Hunt, which sells for $4.50 and may be obtained from the McGraw-Hill Book Co. of this city. This book is especially adapted to students who are just beginning to study the subject of mineralogy. It is profusely illustrated and comprehensive enough to enable one to identify the common minerals. It also discusses the use of the blow pipe and gives a table for the determination of the minerals described in the text. You should supplement your reading by visits to any mineral collections that are available near you for inspection.

No better book for gaining an insight into geological forces and processes is available than one called "Geology Applied to Mining," by J. E. Spurr, which is published by the McGraw-Hill Book Co., and sells for $2.50. It would pay to communicate with the University of Idaho at Moscow, as we understand that some of the western universities have courses in mineralogy and prospecting especially designed to aid the men in the field. Perhaps the University of Idaho can help you, for if it has such a course we would by all means advise your taking it.

One of the best things that you could do would be to get in touch with some prospector who is planning to make an excursion in the field. If he is of the right type and you can persuade him to take you along we are sure you could gather much practical information from him. It would be advisable some time or other to visit a good mining operation in order to obtain some familiarity with the way in which it is being conducted. Perhaps your boys are old enough to obtain a position as a surveyor's helper or an aid in the assay department of a mining company. This would help to make them acquainted with the work of mining. There is much that you can do while taking such a practical step, and that is to become familiar with mineralogy and geological principles.

In the purchase of a mine—we assume that prospect is meant—it would be advisable to obtain the counsel of a competent mining engineer. Some prospects can be obtained for a song; others have prices tagged to them entirely disproportionate to their development. By all means work upon a likely looking prospect. Perhaps the best solution would be to take an option on a property having encouraging indications upon it—the option to run for a specified time, at the end of which purchase could be made at a certain price. This would avoid making an initial outlay that might not only prove embarrassing at the start, but disappointing as the work progresses.

The plans of our contributor are worthy of commendation. Instead of spending a vacation of hunting, fishing, and nothing but play, he intends to devote that period to the equally healthful pursuit—mining and prospecting—which may return him and his sons also educational and possibly pecuniary advantages.

No American Market for Antimony Ores

"I would consider it a great favor if you would supply me with some information regarding a market for an antimonial sulphide ore, should such a market exist. The supply I have in mind is a small body of nearly pure stibnite, containing only traces of gold and silver and no lead. The ledge is located in the Wood River mining district of Idaho. An inquiry to the Salt Lake office of the American Smelting & Refining Co. merely brought the reply that that company had there no antimony smelter."

You will have considerable difficulty in marketing antimony sulphide ore. The price of antimony is generally too low to permit profitable operation of antimony deposits in the United States. At the moment we do not know of a single American smelter that is in the market for such material. Some smelters produce antimonial lead, but only because the antimony is obtained in the treatment of lead ores.

Societies, Addresses and Reports

Rock Drills and Drill Steel Discussed at San Francisco Meeting

Carr Bit Was Forerunner of Present Type of Double-taper Four-point Bit—Importance of Using Oil in Tempering to Assure Toughness

H. L. TERWILLIGER, of the Ingersoll Rand company, presented a paper on drill steel and rock drill difficulties at the San Francisco Section of the A.I.M.E., on Dec. 11, 1923. In the absence of Mr. Terwilliger, C. S. Culp read the paper. The following significant statements were made:

"Those that have not had occasion to follow the development of the rock drill bit will no doubt ask, Why use a double taper? This can be best answered by recalling the fact that eight or ten years ago there was hardly a mine in this part of the country but what used the Carr bit. This was designed by an expert blacksmith by the name of Carr, but many people who used or tried to use it, thought that it was only an ordinary bit. This was not the case, as the Carr bit was designed along scientific lines and the inventor recognized that, in previous designs, when the corners were worn off of the drill steel, the drilling speed began to decrease because with these old designs it was the corners of the steel that determined the free cutting; when the corners wore away, clearance was lost and binding soon took place. The Carr bit was so designed that when the corners went, there was still a reaming edge on the steel to cut the hole to size. This was accomplished by making the taper of the bit back of the corner 5 deg., as this provided not only a strong support for the corner but it made possible the forming of the reaming edge. The Carr bit was a single-edge bit and the hole in the center was punched out rather large, the idea being that the bit should chisel the rock and not pulverize it.

Present Four-point Bit a Double Carr Bit

"This type of bit met with great success in drilling but it was difficult to form, as the ordinary blacksmith would lose sight of the necessity for keeping the corners and reaming edges drawn out, even when using a sharpening machine, while the ordinary hand smith would seldom give the matter sufficient thought to properly form the bit. The Carr bit is seldom seen in use now but it is mentioned because it was the forerunner of the present double taper 4-point bit. The present bit is in reality a double Carr bit, as the 5 deg. taper gives the same reinforced corners which do the reaming after the initial corners have been worn away.

"One of the most interesting experiences that comes to mind is where a report came to us from a large construction job, indicating that excessive piston breakage was taking place on the rock drills. The report was accompanied by a request that one of our men be sent to the job to make adjustments on broken pistons. Our representative visited the warehouse on this particular work and found a great deal of excitement among those in charge, as the men operating the contracts considered that the breakage was due to defective material. Careful investigation disclosed that nearly every one of the broken pistons had been returned from one particular heading, and that there was very little breakage of pistons on other parts of the same contract. The representative therefore concentrated his investigations at the heading where the trouble was taking place and he eventually went to the blacksmith shop, where he found that the blacksmiths were not only careless in the forming of the shanks but were also careless in tempering. As the job was extensive, which meant that there were two or three thousand pieces of steel with shanks improperly made and this could not be corrected in one shift or one day, it was therefore necessary to obtain permission to make the necessary changes. Our representative accordingly went to the men in charge of the contract and volunteered to take charge of their blacksmith shop, to make the necessary corrections, and to put all their steel in proper shape. It was understood that if this did not overcome the piston breakage we would then be able to consider any adjustments which might be necessary. The man in charge of this contract was somewhat doubtful of our ability to prove our claim, but gave the opportunity. All steel from the heading was reshanked, the ends of the shanks were properly ground and oil treated, and the bits on this steel were brought up to standard. Sixty days after this work was done, we received a letter from the man in charge of this contract, advising us that the piston breakage had stopped and he acknowledged that the diagnosis which had been made of their troubles was correct.

"In the mining field we receive many communications indicating that rock drills are extravagant in the use of repair parts, but we usually ask the mining men to forward the broken parts to us for inspection, if one of our men is not on the ground, as these returned parts will as a rule give us an indication of where we are to look for trouble and enable us to send the man who can do the most good. In most cases it comes down to our drill steel service man going to their blacksmith shops and making a study of their methods and pointing out where they are not up to standard. All of the rock drill manufacturers furnish charts showing how steels should be made and how they should be tempered, but the most common trouble is the making of shanks with oval ends or with flat ends of insufficient area. This always results in the cupping of the end of the piston. When a piston begins to cup, it is only a matter of hours when pieces of steel begin to split off and the piston is ruined. A flat end is required on the shank of the drill steel, perpendicular to the axis of the steel with just enough of the corners knocked off so that any slight swelling due to the continual pounding which it gets from the piston of the drill will not permit it to stick in the chuck of the machine. A very important part is, of course, the tempering in oil which makes the steel tough instead of hard and brittle.

"We find it necessary to watch the blacksmith very closely on the proper tempering of the shanks, as they frequently work out a system of their own which they personally consider superior to the oil treatment. They get away from the oil treatment as often as possible and use cold water because they think it simpler. This means that it is possible to get only a few shanks which are properly tempered and it is impossible to get them uniform, when handling the large number of steels that most mines have to handle. Any of the rock drill manufacturers can give specific instructions as to how to install oil tempering equipment, obtaining uniform results upon the shanks.

Proper Form of Bit Drifted Away from in Shop at Times

"While troubles that are encountered due to improperly formed shanks have been mentioned, it appears to be just as easy for blacksmiths and sharpener operators to drift away from the proper form of bit. One of our service men was called to a mining property in this state not so long ago, where the superintendent reported that machines recently purchased were not up to standard in drilling capacity, and that it was difficult to drill a hole that would not rifle. The superintendent did say that these machines were working in a different place than some of the older machines and the ground might be different. Our rock drill service man looked at these machines and found that even he could not drill a hole that would not rifle. He then pulled a machine from another part of the mine and put it in the same place as he had been working the other machine and found that this would not drill a hole without rifling. This readily led to the conclusion that the ground had something to do with it, but it also suggested that the drill steel used might not be just right. The drill steel used was the regular 4-pt. bit with the full 14 deg. flare, made in a sharpening machine. Our representative went to the blacksmith shop to see if they had gaging blocks with which to make the double taper bit, and not finding them, he borrowed a set from a neighboring mine just to make a few double-taper bits. This double-taper steel, when put in use, stopped the rifling difficulties immediately and when that stopped there was of course no loss of time in drilling. It is easy to see how the taking down of projecting corners of the 14 deg. taper bit, and replacing them with a 5 deg. taper, would stop the rifling. The sharp corners with the wide flare were the cause of grooving and the drill followed the spiral groove down, as the corners were doing all of the cutting on the outside diameter of the hole. When the double taper bit was put in use, the reaming action did away with the rifling."

Recent Technical Publications

Reviews, Abstracts, and References

How to Express Ourselves

English for Engineers. By S. A. Harbarger. McGraw-Hill Book Co., New York City. Price, $2.

Though the practice of engineering requires precise and logical thinking, engineers have no reputation for precision in the use of the English language. There are some brilliant exceptions, usually among the older men, but unless an engineer has taken particular pains to read good books and has studied the art of written communication, his literary efforts are apt to be sloppy. In our college days, when we were night editor of *The Michigan Daily*, we recall having great difficulty making even mere reporters think that we knew anything about what we were doing. They were literary and law students; we were only a "rough-neck" engineer, and, incidentally the only one on the staff. But engineers should not think that the proper use of the English language is unimportant; they have letters to write, reports to make, instructions to formulate, jobs to apply for, telegrams to send, material to order, and lots of other things to do wherein a clear and concise wording is advantageous. So books like this of Professor Harbarger's should serve a useful purpose.

This volume tells why the use of good English should be cultivated, and gives general rules for expressing one's self to the best advantage. Particular attention is given to letters of application, inquiry, instruction, and explanation; to sales letters, order letters, and dictation; to telegrams; and to the writing of abstracts, summaries, book reviews, editorials, technical articles, and engineering reports. Nothing is said about the use of individual words; it is general principles that are stressed. Many examples and excerpts from other writers are included, a large number of which are from the *Engineering News-Record*. The *Engineering and Mining Journal-Press* does not seem to be quoted once; but perhaps the author is not a subscriber. The appeal of the book is principally to engineering students, though it contains much meat for graduates as well.

We are told that in reviewing a book we should give our judgment as to "1. The truth and accuracy of the subject matter." We believe just about everything the author says. "2. The scope or comprehensiveness of the treatment." Naturally, in a book of 257 small pages covering such a large subject, the treatment cannot be very comprehensive, but we believe it to be adequate for the purpose. "3. The effectiveness of the method of presentation—clearness, detail, accessibility, style." In these points we should mark the book G +, or maybe E—. "4. The weaknesses, if any." We noticed no particularly weak points. There are a few more footnotes than seem necessary. Who was it said that footnotes are like little dogs running around, barking at the text, and distracting the reader's attention? "5. The final value of the book or article." After what we have said regarding the first four points, this must be a pretty good little book, and one that we can recommend. E. H. ROBIE.

Powdered Coal—"Determination of the Fineness of Powdered Coal" is discussed in U. S. Bureau of Mines *Reports of Investigations* No. 2,545, 14 pages, obtainable on request from the Bureau at Washington, D. C. Powdered coal, as ordinarily used, contains 70 per cent or more of 200-mesh material, so that it is difficult to make an accurate sizing analysis. A standard method is here worked out, both for precision determinations and for routine work by machine screening.

Russian Manganese — Those interested in the manganese industry in Russia will find considerable data regarding recent production, prices, and prospects for the future in a 3-page article in the *Russian Review* for Dec. 1. (Russian Information Bureau, 1726 21st St., N. W. Washington, D. C.; price 15c.)

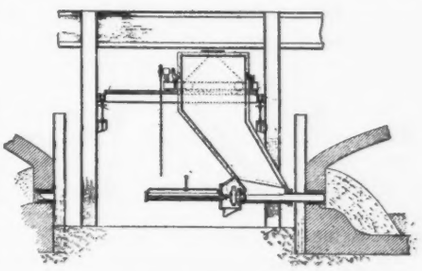
Graphite—Tests recently carried out to find what graphite was the best for brass-melting crucibles showed that Alabama graphite bonded with American clays gave superior service. Madagascar graphite was second, Ceylon graphite third, and Canadian graphite, which had been recommended very highly because of its structure, was the worst of all. The report is contained in a 5-page paper just issued for free distribution by the U. S. Bureau of Mines, Washington, D. C. as *Reports of Investigations* No. 2,542.

Mine Ventilation — The *Proceedings* of the Australasian Institute of Mining and Metallurgy, No. 49, dated March 31, 1923, (Melbourne, price not stated) contains a 24-page discussion by T. G. Hanton and others on "Ventilating Metalliferous Mines: A Method of Attack." An account is given of the development and completion of the Zinc Corporation's ventilation scheme.

Mineral Resources—Recent chapters of "Mineral Resources" issued by the U. S. Geological Survey, Washington, D. C. include: "Tin in 1922," 4 pages; "Secondary Metals in 1922," 19 pages; "Gold, Silver, Copper, and Lead in South Dakota and Wyoming in 1922," 6 pages; "Barytes and Barium Products in 1922," 12 pages; "Mica in 1922," 12 pages; "Slate in 1922," 11 pages; "Sulphur and Pyrites in 1922," 5 pages; "Silica in 1922," 4 pages; "Gold, Silver, Copper, Lead, and Zinc in New Mexico and Texas in 1922," 16 pages; and "Lime in 1922," 12 pages. Any of these papers may be obtained on request from the Survey.

PATENTS

Charging Reverberatories—No. 1,469,327. Oct. 2, 1923. A. G. McGregor, Warren, Ariz. A means for charging reverberatory furnaces which will be made clear by the accompanying illustration. A hopper containing the material to be charged is mounted on a traveling crane moving parallel to the furnace side wall. At the bottom of



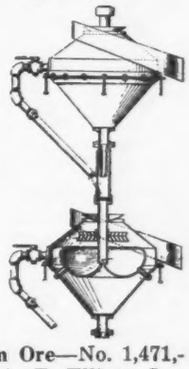
the hopper is a rotatable tube which can be extended into holes in the side wall of the furnace, the charge being forced through the tube and into the furnace by a piston.

Ball Mill Lining—No. 1,470,597. Oct. 16, 1923. J. J. Denny and R. B. Watson, Cobalt, Ont. This patent covers the use of a rubber lining for ball mills which was described in the *Journal-Press* of Sept. 22, 1923.

Air Separator—No. 1,470,892. Oct. 16, 1923. T. J. Sturtevant, Wellesley, Mass., assignor to Sturtevant Mill Co., Boston. An air separator for the sizing of fine dry material by centrifugal action, an inner and outer vessel being provided to hold the two products.

Sintering Machine—No. 1,471,402. Oct. 23, 1923. R. L. Lloyd, New York City, assignor to Dwight & Lloyd Sintering Co., New York City. The patent covers details in the design of the Dwight & Lloyd sintering machine.

Flotation Machine — No. 1,470,350. Oct. 9, 1923. A. L. Court, San Francisco. Double conical units are placed one above the other, agitation being provided by impellers revolving within each unit as shown in the accompanying illustration.



Leaching Vanadium Ore—No. 1,471,514. Oct. 23, 1923. A. T. Elliott, Los Angeles. Ore containing vanadium and uranium is treated with a solution of a nitrate of an alkali metal in the presence of an acid, the solution separated from the residue, and then treated to remove metals other than vanadium and uranium. The uranium is then removed by treatment with an alkali metal hydrate. The remaining solution is treated with a metallic salt to precipate the vanadium as a metallic vanadate. The production and use of the alkali metal nitrate is cyclic.

MEN YOU SHOULD KNOW ABOUT

William Motherwell, is conducting flotation tests at Stockton, Calif.

T. H. France has returned from an inspection of the diamond fields of British Guiana.

D. S. McAfee, of the Dorr Co., has returned to New York after a trip through the Middle West.

F. L. Hess and **George Steiger** have returned from Florida, where they have been doing geologic work.

Lester W. Strauss has returned to Valparaiso, Chile, after several months' professional work in Bolivia.

Sam Hugh Brockunier, formerly of the *Engineering and Mining Journal* staff, was in New York last week.

Donald F. Irvin, who spent the month of December in Oklahoma and Texas, will return to California in January.

George R. MacLaren, of the Kirkland Gold, has been appointed manager of the Argonaut property in Larder Lake.

George H. Garrey, of Philadelphia, has been in Nevada, in the Ely and Hamilton districts, on professional business.

William Kemp, who has been operating at Barranca del Cobre, in western Chihuahua, has returned to Tucson, Ariz.

Carl F. Schaber, formerly general superintendent for the Fluorspar Distributors, Inc., has assumed charge of the Nelly Bly mine for the Anita Copper Co., at Lordsburg, N. M.

Prof. G. D. Louderback, of the University of California, has spent some time working in the paleontological laboratory of the U. S. Geological Survey and at the National Museum.

Arthur J. Crowley, of Sulphur, Nev., who has recently been working with the Arthur D. Little company on methods for the recovery of sulphur from Nevada ores, was in New York City last week.

Lloyd C. White, of Burch, Hershey & White, has returned to San Francisco. During the last year he designed and supervised the erection of a new sampling plant for the Bunker Hill smelter at Kellogg, Idaho.

Charles W. Merrill, the recipient of the James Douglas medal for distinguished services in metallurgical research, was given an honorary luncheon by the Engineers' Club of San Francisco on Dec. 17, 1923.

Fletcher Hamilton, former state mineralogist of California, recently conducted hearings in behalf of the Senate Gold and Silver Inquiry at Virginia City, Tonopah, and Round Mountain, Nev., and at Los Angeles, Calif.

Robert J. Grant's nomination by the President to be Director of the Mint has been confirmed by the Senate. **Frank E. Shepard's** nomination to succeed Mr. Grant as Superintendent of the Mint at Denver has also been confirmed.

James R. Dodworth, chairman of the board of directors of the Night Hawk Peninsular Mines, and **J. Albert McKay,** vice-president of the company, both of Pittsburgh, Pa., recently paid a visit of inspection to the property.

C. E. Abbott has been appointed manager of mines and quarries of the Tennessee Coal, Iron & Railroad Co., vice Edwin Ball, deceased. Mr. Abbott was formerly general superintendent of iron mines and quarries of the same company.

A. G. Burrows

A. G. Burrows, geologist of the Ontario Department of Mines, has just returned from field work in northern Ontario.

Ernest W. Ellis, mining engineer of Boise, Idaho, has been appointed instructor in mining and metallurgy in the School of Mines at the University of Idaho, and assistant metallurgist of the Idaho Bureau of Mines and Geology, in place of **C. B. Marshall,** who has resigned.

William B. Davinson, master mechanic at the new Phelps Dodge concentrator, at Warren, Ariz., has resigned his position and will leave for Bolivia, South America, on Jan. 1, where he has accepted the position of master mechanic at the tin mines and mills of the Guggenheim property in that country.

Henry Walker, a mining engineer who is serving as deputy chief inspector of mines for Great Britain, will visit this country in February. Arrangements are being made by George S. Rice, the chief mining engineer of the Bureau of Mines, which will make possible first-hand observations as to safety methods employed in American mines.

General and Mrs. John C. Greenway, of Warren, Ariz., were guests of honor at a reception given them at the Warren Country Club by the employees of the Calumet & Arizona Mining Co., of which General Greenway is the general manager. The hosts numbered about 300 of the mine and smelter employees, and their gifts to the newly married couple consisted of a cabinet photograph and a sterling silver tea service.

W. T. Hamilton, manager of the Moctezuma Copper Co., of Nacozari, Mexico, has announced his intention of leaving the service of the company on Jan. 1. He will go into partnership with **Ira B. Joralemon,** formerly assistant general manager of the New Cornelia Copper Co. and the Calumet & Arizona Mining Co. **Frank Ayer,** now general superintendent of the Moctezuma Copper Co., will succeed Mr. Hamilton as manager, and **H. H. Horton,** now fiscal agent of the company, will become assistant manager.

George H. Harbordt, who has been first vice-president and assistant general manager of the Cia. Minera de Peñoles, S. A., and all of its subsidiary companies, will on Jan. 1, 1924, assume the duties of first vice-president and general manager. **Heath Steele,** president of the company, who has been in Mexico since 1921, will after June of next year again make his headquarters with the American Metal Co., Ltd., in New York. Cia. Minera de Peñoles, S. A., and subsidiaries are controlled by the American Metal Co., Ltd., of New York.

Donald H. Fairchild, of Fairchild & Fairchild, Chicago, has recently completed a mining reconnaissance trip through Arizona, New Mexico, California, Utah, and Colorado.

O. H. Fairchild, of Fairchild & Fairchild, Chicago, is now at Santa Maria, Calif., on behalf of the Universal Oil Products Co. in its suit with Standard Oil Co. of California. Mr. Fairchild is engineer for the Universal Oil Products Co. and went recently to Japan for his company to supervise an oil-cracking plant in Tokio. As the supplies for this plant were destroyed by the earthquake and the fire which followed, he returned to the United States.

Arthur Moore, who has had a long experience in artesian boring in Queensland, Australia, and who was the last driller in charge of the now abandoned oil bore at Roma, in that state, has lately spent eight months in the United States in a search for up-to-date information regarding oil boring. On his return to Brisbane he said he had formed the opinion that the rotary drill was not the best to use for oil prospecting in Queensland in hard rock; he preferred the ordinary artesian plant. He said, also, that money was easily obtainable for oil ventures in America, even when the prospects did not appear as good as some in Queensland.

OBITUARY

Dr. J. E. Stead, F. R. S., metallurgical chemist, of 11 Queens Terrace, Middlesbrough, England, died recently in that country.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary of the Week

THE Ohio Copper Co. produced during November 664,285 lb. of refined copper in the form of precipitate at its mine at Lark, Utah. This comes from leaching-in-place operations, the scale of which has since been increased.

A 600-ton mill is planned by the Canadian Associated Goldfields at Larder Lake, northern Ontario.

Reports state that the Thompson Smelter, at Wabuska, Nev., is likely to resume operations.

New era seems to be ahead for Park City, pioneer silver-lead district of Utah.

The Calumet & Hecla Consolidated is increasing its development operations as the labor situation improves.

A model surface plant is being constructed by the Castile Mining Co. at its Eureka iron mine, on the Gogebic range.

The Tidewater Copper Co., operating on Vancouver Island, B. C., has suspended operations.

The Real del Monte is milling 3,500 tons per day at Pachuca, Mexico.

Senator Key Pittman wants a thorough investigation of the War Minerals Relief administration.

Placer operations in Park County, Colo., show increased activity.

The Tom Reed company may build a mill at the Katherine mine, near Kingman, Ariz.

Ohio Copper Co. Made 664,285 Lb. of Metal for 6.64c. per Lb.

Output from "In Place" Leaching During November — Scale of Operations Increased in December

The November production by the Ohio Copper Co., when operations were carried on with an average flow of 798 gal. per minute, and the full flow of 1,500 gal. per minute had not yet been applied, amounted to 664,285 net pounds of copper. The company is leaching "in place" at Lark, Utah. This breaks the record of past production, even at the time when the company was operating a 2,200-ton mill. The cost of production was 6.64c. a pound, which, with an average sale price of 12.61c., gave the company a profit of 5.97c. a pound or a total profit of $38,466, this being at the rate of almost half a million dollars a year. The rate of recovery during November was not so high as it had been with the experimental plant, but this was due to the difficulties incidental to "warming up" a new and larger installation. Recoveries in December, however, have shown an increase, the rate during the first fifteen days of the month having been over 98 per cent. The cost of production per pound during November was considerably lower than the average of costs of 7.9c. per pound during the first five months of the year, when the experimental plant was running. Ordinary canyon water is used for leaching without any chemicals. Precipitation is on de-tinned scrap iron in wooden launders.

Cardiff Shipping 50 Tons Rich Lead-Silver Ore Daily

The Cardiff mine in Big Cottonwood Canyon, Utah, has declared a dividend of 10c. a share, amounting to $50,000, and bringing the total thus far to $25,000. The new ore body is holding out well, and the physical condition of the mine is excellent. Shipments are being made at the rate of 50 to 60 tons per day of ore carrying about 30 per cent lead and 20 oz. silver.

Las Dos Estrellas Mill Capacity Increased to 2,000 Tons

The Cia. Minera Las Dos Estrellas is increasing the capacity of its mill in the State of Michoacan, Mexico, from 1,400 to 2,000 tons per day. Some of the tube mills have been converted to ball mills and an additional Butter's filter and Butter's clarifier and three bowl classifiers have been purchased and are being installed.

Nevada Rand Ships Small Car

The Nevada Rand mine, in Mineral County, Nev., has produced another small car of ore. The tenor is not stated. This mine contains small bodies of very rich gold and silver ore, the valuable minerals being native gold with some silver sulphides and chlorides. The vein is at present being developed on the 250 level, by drifting and raising, and a limited tonnage of ore of good grade is opened up. Operations will continue during the winter, as the weather is not usually severe.

Calumet & Hecla Starts New Development

No. 1 North Kearsarge Will Be Opened —German Workers Continue to Immigrate—Several Hundred Arrivals

Improvement in the supply of labor in the Michigan copper district has prompted Calumet & Hecla Consolidated to reopen No. 1 North Kearsarge shaft for development work. A small force will be put to work in shaft sinking and drifting. The shaft, which has been retimbered throughout, is bottomed at a depth of 4,228 ft., 30 ft. below the 30th level. When mining operations ceased in 1920, the character of the rock in the drifts at depth was unusually good. The best ground was developed by the 36th level south drift, and the 37th and 38th levels north and south disclosed stretches of fairly good vein rock. Electric pumps installed on the 17th and 31st levels are adequately handling the flow of water.

Mines in the south end of the district, including Copper Range, Quincy and Isle Royale, now are also receiving considerable quotas of German immigrants and are building up their underground forces. Several hundred have arrived in the district since the movement started, the majority going to Calumet, to the north, where they were given work in the Calumet & Hecla conglomerate shafts and the Ahmeek mine. Of late, the number of arrivals in the south end of the district has increased and generally the labor situation has taken a decided turn for the better.

Larder Lake to Have 600-Ton Mill, Is Plan

Canadian Associated Goldfields, in Ontario, Seems To Have Mine, Though Overcapitalized—Crown Reserve Develops Same Vein System

THE Canadian Associated Goldfields, of Larder Lake, has decided to start the construction of a 600-ton mill, which it is expected to have completed and in operation next year. This company has had a rather remarkable history. The orignal company was formed a number of year ago to take over several Larder Lake properties which mining men of experience considered of little value. As time passed these opinions were proved to be true, but the company was highly successful in its stock-selling campaign and made extravagant promises and estimates to its stockholders. Official statements were made frequently of ore reserves running into many millions and shareholders were advised of the company's plans to construct 5,000-ton mill units, with an ultimate capacity of 10,000 to 20,000 tons a day. A few years ago the company practically demanded of the Ontario Government that a branch railroad should be constructed to the property, but when advised that this would only be done if a complete examination of the properties by government engineers would justify such an expenditure, the demand for a railway was quickly allowed to drop.

Has Had Checkered Career

Several times the company was considered a proper subject for an investigation by the government but nothing was done. In the meantime the company was reorganized several times, with a constantly increasing capital, until finally the authorized share capital was $30,000,000, practically all of which is issued. The time was rapidly approaching when shareholders could not much longer be deceived as to the character of the investment, when the company acquired, for a price of $10,000, a claim adjoining the Crown Reserve property at Pancake Lake. Development on this property has proved to be successful and all the indications point to the company having developed a profitable mine, although not one that will justify any such capital as $30,000,000. The main vein has been proved on four levels to a depth of 500 ft. for a length of approximately 1,200 ft. The width varies up to 52 ft. with an average of probably over 30 ft. Values are reported to be about $8 a ton. Recently the vein has been cut at 750 ft., and widths and values are understood to be about the same. Several other veins are known, but practically no work has been done on them to date.

The Crown Reserve is operating on the extension of this same vein system and is developing an important mine; and, as a matter of fact, this section is today the most important new gold development in the province. The Crown Reserve has explored its property to 500 ft. and development to date on the three proved veins indicates an average of about $8 over widths of 20 to 30 ft. It is understood that the deepest work has shown the best values, and sinking is to be continued. Both the Associated Goldfields and the Crown Reserve seem assured of profitable mines, and as they are developing the same veins it is, in some respects, perhaps unfortunate that both properties could not be operated by one company, but in view of the past history and present capital of the Associated, this is considered impossible.

The Crown Reserve has an authorized capital of $4,000,000, of which $2,400,000 is issued. The company has not announced any plans regarding a mill, but it is considered probable that construction will start next year, when the branch line of the T. & N. O. Rys., which is being built to the property, is completed.

Lone Maid Wants Aërial Tram

The Anyox syndicate that bonded the Lone Maid mine, adjoining the Esperanza, in the Alice Arm district in British Columbia, has paid the final installment, and has started work in the hope of blocking out sufficient ore to warrant the erection of an aërial tramway. The vein, which is opened by a tunnel, is 5 ft. wide, and a trial shipment is said to have yielded $52 in gold and silver per ton. At the present time there is no means of moving ore, other than rawhiding, which renders transportation too costly for this grade of ore.

Hewitt and Lorna Doone Mines Involved in Litigation

The Supreme Court of Canada has sustained the ruling of Justice Murphy in the British Columbia Court of Appeal, whereby Clarence Cunningham is ordered to make an accounting to Robert Insinger, banker of Spokane. In August, 1918, Mr. Cunningham, who is a well-known Slocan mine operator, agreed to purchase the Hewitt and Lorna Doone mines, in the Slocan, for $175,000. Unable to meet the first payment of half the purchase price, Mr. Cunningham paid $50,000 to the Insinger syndicate, and was granted an extension of time, before the expiration of which he notified the owners that he did not intend to make further payments, and the option was cancelled. Meanwhile Cunningham changed his mind and paid to Insinger's account payments due to that time, keeping back $11,776 until Insinger gave him the title deeds to the properties. The case hinges on this sum and on royalties on ore taken from the mines during the period that the option was in effect.

Rich Ore in Esperanza

The owners of the Esperanza mine, at Alice Arm, B. C., have opened a shoot of rich silver ore in the tunnel above the Baldy tunnel. The vein is about 10 ft. wide, and carries a 6-in. stringer of high-grade ore, showing flake and wire silver on the footwall and three feet of shipping ore on the hanging wall. The ore between is milling grade. About thirty tons of the high-grade ore is sacked, ready for shipping. This ore is said to be richer than anything previously found in the mine.

Kirkland Gold Will Probably Suspend Production

It is understood that the Kirkland Gold, which is controlled by the Beaver company, of Cobalt, will soon close its mill at Kirkland Lake. The average recovery during the first nine months of the present year was only $5.15 a top, which did not allow a profit, and the finances of the company will not permit of an extensive exploration program, which might result in the discovery of higher grade ore. Negotiations for the financing of the company have been under way, and it is believed that efforts have been made to interest the Teck-Hughes. The latter company adjoins the Kirkland Gold, and is in a strong position as to ore reserves, profits, and cash. If it were to take over the Kirkland Gold the property would be thoroughly developed.

Queen Lebel Option Dropped

John Taylor & Sons, of London, have dropped their option on the Queen Lebel property, in Ontario. Development work was carried to 300 ft. Following the reorganization of the Bidgood, which resulted in the formation of a $3,000,000 company, of which $1,500,000 was issued for the property, it is announced the arrangements have been made to resume work. The recent discovery on the Lebel lode enhances the speculative value of the Bigwood property.

Verde Jerome Will Deepen Shaft and Prospect

The Verde property, which adjoins the Verde Central holdings of the Jerome district, in Arizona, is said to be fully financed for executing a large program of development and construction. Preparations are being made for deepening the present 160-ft. shaft. W. B. Gohring, former mine superintendent of the Calumet & Arizona, has been placed in charge of the work. The Verde Jerome holdings comprise thirty claims, and the work to be done will prospect veins similar to that on which the Verde Central has found ore. Unlike the latter property, ore has been found at the surface of the Verde Jerome claims, and development will be directed toward areas beneath favorable-looking outcrops.

Tom Reed to Finance Mill Construction for Katherine Mine

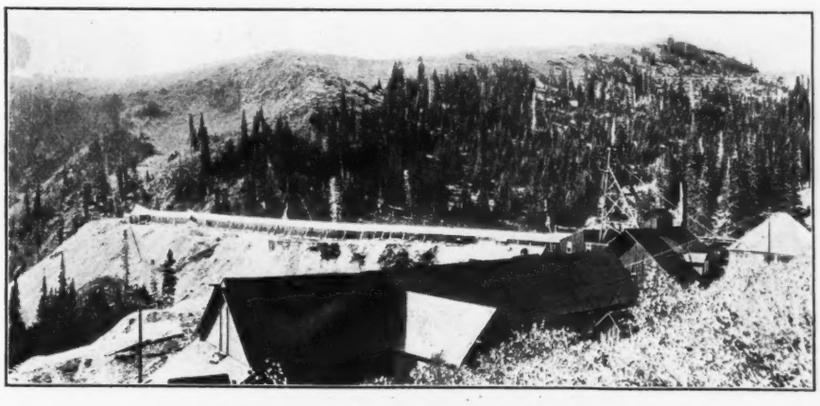
IT IS reported that the Tom Reed Gold Mines Co. of Oatman, Ariz., has entered into an agreement by which it will take over the Katherine property, which is near the Colorado River, north of Kingman. Negotiations are said to be completed, and it is expected that the construction of the new mill and other needed work will be begun by the Tom Reed, for which it is to receive a large part of the stock issue. The Katherine is one of the most promising prospects in this part of the northern Arizona; the orebody has been developed to a depth of 600 ft.

Esperanza Financed to Develop Mine and Reconstruct Mill

The London directors of the Cia. Esperanza, S. A., have appropriated from funds obtained by the sale of new stock, $500,000 for mine development, retimbering shafts, and the reconstruction of the mill at El Oro, in Mexico. The company has a large tonnage of old fills, principally of low grade, and with the improvements and increased capacity of the mill to 1,000 tons, expects to be able to treat this ore and show a fair margin of profit.

Santa Gertrudis Erects New Hoist at San Francisco Shaft

The Cia. de Santa Gertrudis, S. A., operating at Pachuca, Mexico, has replaced the hoist of the San Francisco shaft, which is used to raise ore from the Don Carlos mine recently taken over under lease, with option to purchase, from the A. S. & R. Co. This property is being worked through the 1,200 level of the old Santa Gertrudis mine. A large vein of high-grade ore was struck a few months ago, from which it is expected that a material increase in production will be made. The company owns a good mill with a daily capacity of 2,000 tons.



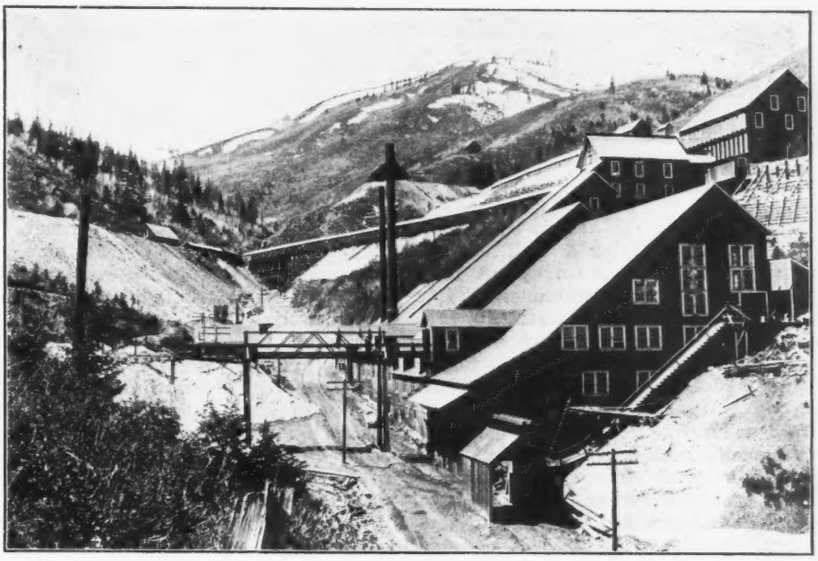
Judge hoisting plant at Park City, Utah

New Era Ahead for Park City, Utah

Purchase of Ontario Control by Lambourne Interests Promises Operating Economies—Customs Zinc Plant Projected—Silver King Sale Rumored

By Arthur B. Parsons
Assistant Editor

EVENTS of the last fortnight, coupled with mine development since the Pittman Act silver purchases were discontinued last June, indicate clearly that Park City, pioneer silver-lead district in Utah, will start the new year under highly favorable conditions.

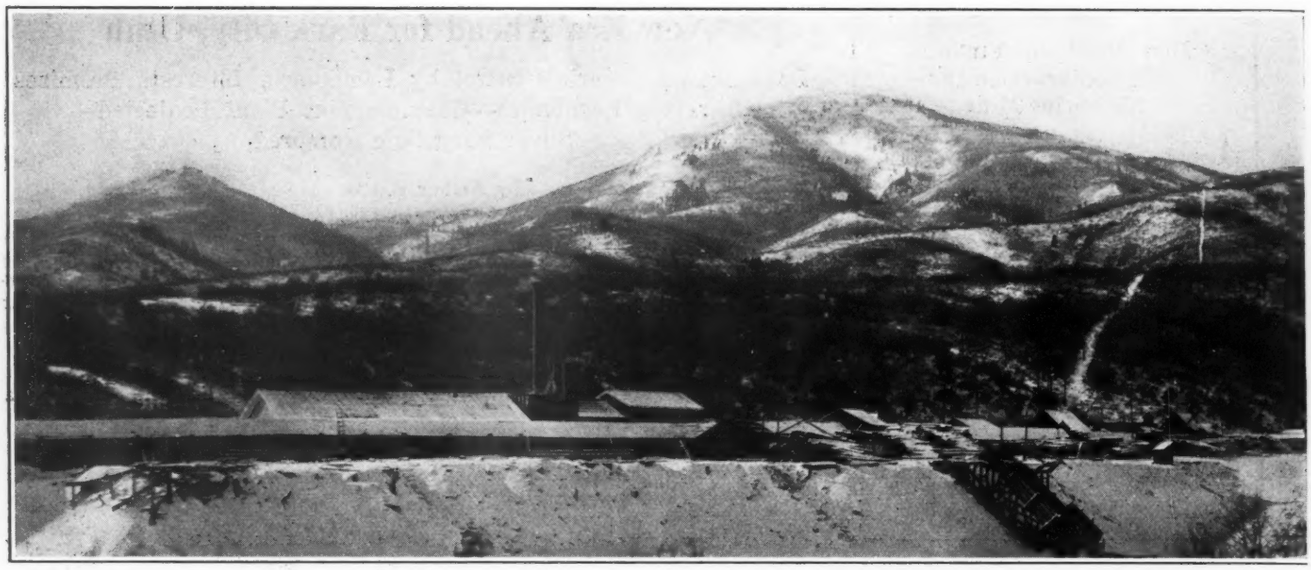


The old Judge mill in Empire canyon

Probably the most significant news is the announcement that engineers representing the Anaconda Copper Mining Co., through its subsidiary, the International Smelting Co., are engaged on a survey of the principal mines, including those of the Park City Mining & Smelting, Park-Utah, and Silver King Coalition companies, for the purpose of estimating the proved and probably reserves of certain classes of lead-zinc ores. If the prospective tonnage is adequate, and terms can be agreed upon for the treatment schedules, it is regarded as certain that the Anaconda company will build a customs metallurgical plant at or near Park City for the separation and recovery of the lead and zinc. The zinc product would go to the electrolytic plant at Great Falls, where Anaconda is anxious to obtain all the rich zinc ore and concentrate that it can. The lead concentrate might go to the International smelter, at Tooele, depending, of course, on the terms of certain existing contracts with the A. S. & R. Co.

Zinc in some of the ore has always been a problem. Much "ore" has been left unmined because the zinc penalty would make it unprofitable to mine it. The Silver King Coalition Co., which completed the construction of a fine new concentrator in 1922, is milling ore of comparatively low average zinc content and saves very little; but some of the veins in the mine contain plenty of zinc, lead, and silver to be profitable if the zinc could be efficiently separated and shipped. The primary purpose of the present survey is to determine how much of such ore is available. Incidentally, new Callow cells have recently been added to the flotation equipment for the purpose of increasing recovery and capacity of the plant.

Zinc, on the other hand, is more important than lead in the ore milled by the Park City Mining & Smelting Co. The company is running the plant on only the day shift at present. The concentrator uses flotation, but it is an old rebuilt structure and could not be made to do really efficient work



Surface plant, tunnel portal, and loading "docks"

without remodeling and re-equipping. The Park City Mining & Smelting Co. owns an electrolytic zinc plant near Park City, where premium slab zinc was made for several years by its predecessor, the Judge Mining & Smelting Co. In October, 1920, the Utah Public Utilities Commission ordered cancelled an advantageous electric power contract under which the Judge company was then operating. The plant has been down ever since, except for calcining zinc concentrate for shipment to Oklahoma retort smelters. The Judge mines contain large reserves of zinc ore—some of high and some of lower grade.

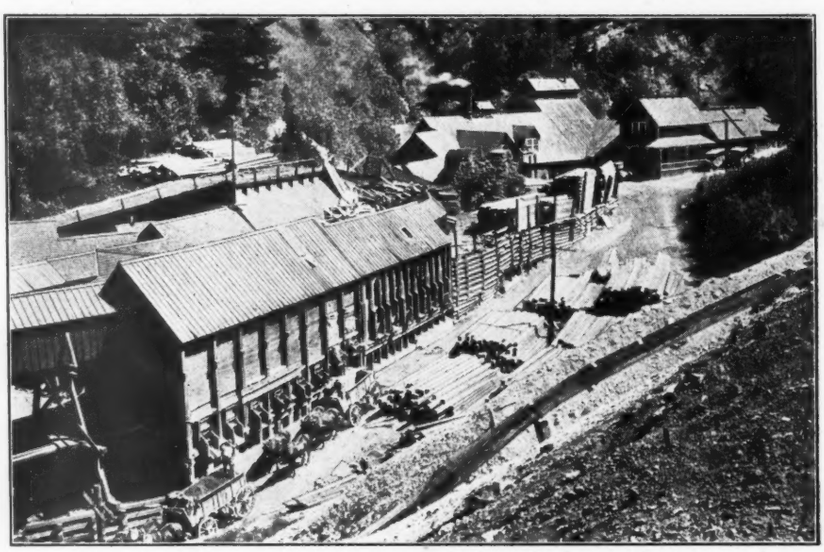
In addition, there is some zinc-bearing ore in the Park-Utah mine and a great deal in the lower levels of the Ontario mine that would help supply the proposed new customs plant. Much of the direct shipping ore from all the properties has borne a heavy penalty for its zinc content. Zinc has been the bane of scores of mine managers, but metallurgists have made rapid strides in developing methods for separating and recovering it. The building of a modern plant at Park City by the Anaconda company would certainly be an important event in the history of the district.

The purchase of the Bamberger and other interests in the Ontario Silver Mining Co. by George W. Lambourne and Cincinnati associates, who now control the Park City Mining & Smelting and Park-Utah companies, will bring under a single management properties covering ten miles of the strike of the famous Ontario-Daly fissure system. This includes the Judge, Daly West, Daly, Ontario, and Park-Utah mines, which together have produced about $89,000,000 and have paid $25,000,000 in dividends. Of this, $15,000,000 came from the Ontario. The principal advantage of centralized control will be increased economy and efficiency in development, transportation, and other phases of operation. Whether a merger of the Ontario company with one or both of the others will eventuate is not stated by Mr. Lambourne. The price involved in the purchase of the Bamberger interest is said in Utah to be approximately $500,000.

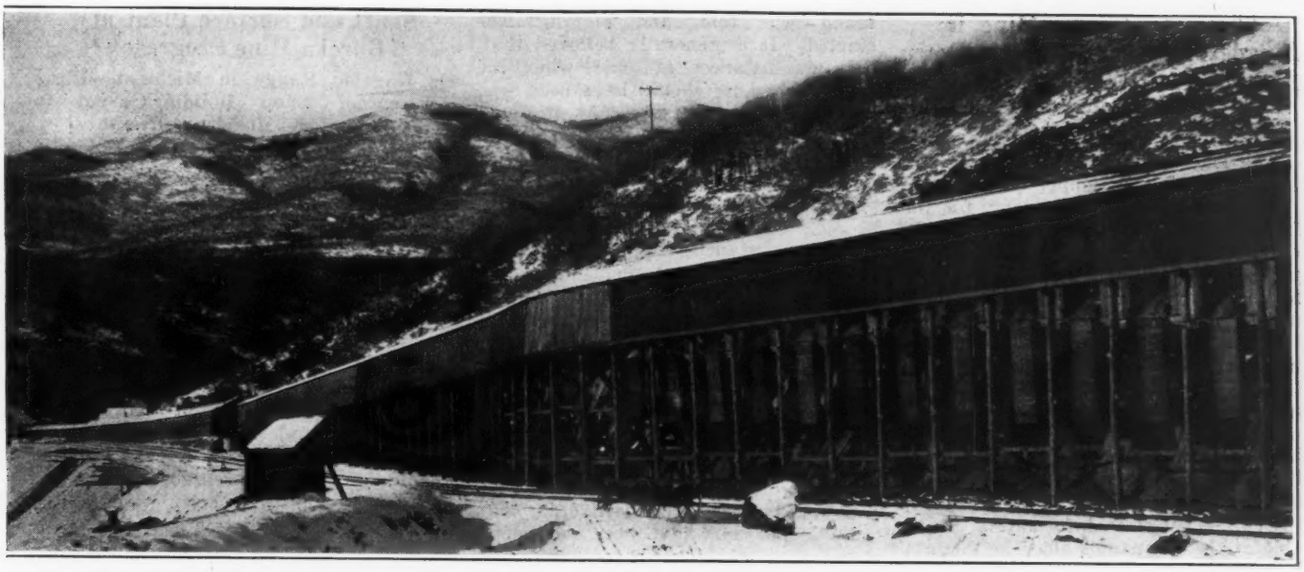
The Ontario ground lies between the Daly and Park-Utah mines and includes a long stretch of unprospected territory. The potential value of this is greatly enhanced by the opening since 1920 of the Park-Utah bonanza orebodies, from which about $3,000,000 has already been taken. This gives a speculative value to the entire east end of the Ontario property beyond the fault that was supposed to have marked the limit of the productive area. The Ontario company owns a four-sevenths interest in the Ontario drain tunnel and control of the Naildriver mine, another Park City property.

A further indication of improvement in the district is the recent increase in ore shipments. Following the completion of the Pittman Act silver purchases, production was subordinated to development work, and, at the Park-Utah, to construction. Now, it is announced the mines are in such condition that the necessary development can be continued without interfering with production. The new branch railroad line to the mouth of the Ontario drain tunnel has been completed, and the Park-Utah loading dock is finished. Mine cars will dump directly into gondola railway cars, thereby effecting a considerably economy in handling the ore. Accommodations are complete for 240 men, and large-scale production will start at once.

The Park City Mining & Smelting Co. has increased its shipments of direct-smelting ore so that the total output including concentrates is around 1,200 tons per week. The Silver King Coalition is shipping at the rate of 1,000 tons of ore and concentrate per



Surface plant at the Judge mine



at the Park-Utah mine at Park City, Utah

week. In the third week of December the Keystone shipped 420 tons and the Ontario 354 tons. This was a large increase for the former, and for the Ontario the first shipment in several months.

Rumors current in Salt Lake City are to the effect that negotiations are under way which may result in the sale to strong eastern interests of the control of the Silver King Coalition, now held by the heirs of Thomas Kearns and David Keith. Color is given to this by the visit of sundry high officials of the company in the east on "mining business." The company has distributed $16,771,490 as dividends, the total for the current year being $942,720.

Silver has always been the most important source of income from the mines of the district, but the ores contain lead, zinc, and copper in sufficient quantity to be important. In addition to the high-grade ore developed, much medium-grade ore is virtually ready for mining. Energetic exploration of the eastern portion and the lower horizons of the Ontario ground is assured; and more economical operations will be possible as a consequence of the Ontario purchase. If the "zinc problem" is satisfactorily solved by the construction of the proposed new customs plant, the residents of Park City, as well as the shareholders in the mines, ought to feel pretty optimistic for the future.

Chino Copper Co. Curtails at Hurley, N. M.

The Chino Copper Co. has laid off approximately 150 men at the mill at Hurley, N. M. The men laid off consist mostly of boilermakers, carpenters, pipe fitters and machinists. All the flotation units except Nos. 6 and 7 and a small unit have been shut down. A considerable number of men at the mines at Santa Rita have likewise been laid off, pursuant of the program of curtailment.

Thompson Smelter in Nevada May Be Restarted

Acquisition of Bluestone Adds to Ore Reserves — Commerce Commission Asked for Differential Rate

Preparations are being made at the mines of the Mason Valley Mines Co. to resume operations, and it is considered likely that its Thompson smelter, one mile from Wabuska, Nev., will soon be started. The Mason Valley Mines Co. recently purchased the Bluestone Copper mine and the branch railroad to the latter mine will be extended to the former, a distance of about one mile. There is an 800-ton flotation plant at the Bluestone and sufficient ore broken and blocked out to keep this plant in operation for some years at full capacity. The majority of the ore will average about 2.5 per cent copper, although there are large bodies which will average up to 20 per cent. In addition the Mason Valley Mines Co. has a large tonnage of oxidized and sulphide ore in its own mines. The Nevada-Douglas Consolidated Copper Co. owns the Western Nevada mine, in which there are large reserves of sulphide ore. All of the above companies shipped ore to the Thompson smelter at Wabuska until preferential freight rates forced its closing.

The Mason Valley Mines Co. has applied to the Interstate Commerce Commission for a differential rate from the copper mines in Plumas County, Calif., which ship a very desirable product for smelting, as between Wabuska and Utah smelters, based upon the length of the haul. In 1921 the freight rate was reduced, but the reduction was nullified by the railroad company, which put in an open car rate to Utah points which equaled the rate to Wabuska. Shipments from the Engels and Walker mines now go regularly to the smelters in Salt Lake and Tooele vallies.

Mill at Beaver, Utah, Planned to Treat Pioche Ore

It is proposed to build a milling plant of 300-ton capacity at Beaver, Utah, to treat the ore of the Combined Metals, Inc., mine at Pioche, Nev., according to a letter to the stockholders of the company. The letter also announces that capitalization will be increased from 1,500,000 shares to 2,000,000 shares, and that money resulting from the sale of stock will be used to pay off the indebtedness of the company, which amounts to $106,884, and for a future reserve. Construction, it is understood, will be undertaken by the Combined Metals Reduction Co., control of which is owned by National Lead Co. E. H. Snyder is president of Combined Metals, Inc.

Empire Development Changes Hands

F. W. Evans, one of the veteran operators in the Joplin-Miami district, has purchased a majority interest in the stock of the Empire Development Co., which has a property in Kansas, north of Hockerville, Okla., consisting of a modern concentrating plant and 100-acre lease. The purchase was made from B. E. Nace and others, of Kansas City, and was consummated there. The consideration was not made public. The mine has been a good producer for several years, and its operation will be continued by the new owner.

Elkhorn Operations Suspended

The East Butte Copper Co. has suspended operations at its Elkhorn property, in Jefferson County, Mont. Adverse weather conditions have made it necessary to suspend mining and milling for the winter. About forty men have been employed at the property up to this time. Production will be resumed in the spring.

Tidewater Copper Mine, in Financial Difficulty, Shuts Down

Property on Vancouver Island—Miners Find Checks Valueless — Concentrate Shipment Held Up

The Tidewater Copper Co., which has been operating a copper property at Sidney Inlet, Vancouver Island, for the last five years, seems to be in financial difficulties. The forty-five men employed by the company were paid off by checks at the end of November, and, arriving at Victoria on Dec. 7, attempted to cash their checks, but the bank refused to honor them. The total amount is about $8,000. The men made application to the Department of Labor, which has held up a load of concentrate, now at Victoria on its way from the mine to the Tacoma smelter, which is said to be worth about $7,000. The only information available at the company's office in Victoria is that the mine is closed down. The Department of Labor has advanced to the men sufficient to take them to their homes, and is holding the concentrate, pending replies to inquiries made to the head office of the company in New York. Sam I. Silverman, of Victoria, is one of the principal shareholders.

The Tidewater mine is well equipped with mill, water-power plant, auxilary Diesel-engine plant, compressor, and usual mining machinery. After three years of steady development the mine was brought to the producing stage in 1920, when one consignment of concentrate was sent to the Tacoma smelter. The mine was then closed, on account of the low price of copper, and was not reopened until the early part of the present year. There is no large reserve of water for the power plant, but during ordinary seasons the rainfall at that point is about 75 in., and keeps the plant supplied during the greater part of the year. The present season has been exceptionally dry, which may account to some extent for the company's present difficulties. It is said that sufficient ore has been developed to supply the mill at capacity (200 tons per day) for two years.

Black Art Fails in Tonopah and Goldfield

William Guest, willow-wand artist and doodle-bug man, appears to be having a little tough luck with his predictions. Mr. Guest came to the Tonopah and Goldfield country six months or so ago and proceeded to advise local people regarding the present and future, principally the latter. He tarried only a short time in Tonopah—only long enough to satisfy himself that the camp had enough ore remaining to produce 5,000 tons per day for the next forty years. This was quite encouraging, as production at present is at the rate of 850 tons per day, and maximum production was at the rate of about 1,600 tons per day.

In Goldfield his advice was sought, the exact depth where ore would be found was told, and digging was started. It is generally believed that, in some instances at least, when the depth where ore should have been was reached, none was there. At any rate some of the work started under his directions has been discontinued. It may be that the next shaft will strike pay ore as prescribed; that remains to be seen. In any event, in addition to the many stanch supporters of the doodle bug, there are plenty of unbelievers, and it is likely that regular methods of finding and mining ore will continue in vogue.

Eureka Holly Mill Nears Completion

The machinery for the addition to the mill of the Eureka Holly Co. at Eureka, Nev., has been delivered, concrete foundations have been set and it is expected that the 100-ton plant will be ready to operate by the end of January. The principal ore reserves are above the 600 level, and it is this upper level ore which will be milled while deeper developments are in progress. Shaft sinking has already been started at the 600 level and the shaft will be sunk to the 1,100 level, where lateral prospecting will be done.

Kennedy Completes Crosscut; Finds 20-Ft. Vein

The Kennedy Mining Company has completed its crosscut on the 4,200-ft. level and has cut the hanging wall quartz at its property at Jackson, Calif. The section of the orebody at this level on the line of the crosscut shows a 20-ft. vein on the footwall, a 38-ft. horse of mineralized country rock and a 23-ft. quartz vein on the hanging wall. The mineralized area is from 76 to 78 ft. in width. The hanging-wall vein is of lower grade than the footwall vein. At present 70 stamps are being operated.

Another Grass Valley Mining Deal

The Golden Center mine at Grass Valley, Calif., has been sold to M. K. Harr, according to local reports, for an approximate price of $500,000, payment to be distributed over a period of five years. The Golden Center mine has been shut down since the war. The area of the mining property is stated to be 450 acres. The mine will be unwatered and exploration started.

Silver Wave Pays Dividend

The Silver Wave Mining Co. of American Fork Canyon, Utah, has declared its fifth dividend of one-tenth of a cent per share, payable Dec. 22. This brings the total by the company thus far to $3,237.50. The Silver Wave property is being worked under a long-time lease by the American Leasing Co.

Shaft and Surface Plant at Eureka Mine Progress

On Gogebic Range in Michigan—Big Fireproof Shop Building Near Completion—Model in Design

The Castile Mining Co. at the new No. 4 shaft of the Eureka mine at Ramsay, Michigan, has the drop shaft at a depth of 81 ft. It is now being sealed in the iron formation. This is considerably deeper than it had originally been planned to carry the drop shaft, but it was going down nicely and the dyke encountered was quite soft. Below the dyke the iron formation is seamy.

The Worden-Allen Co. of Milwaukee has about completed a 60 by 240-ft. shop building at the new Eureka shaft. The building is of fireproof construction, steel frame with brick walls, and is to house all of the maintenance operations of the Eureka and Asteroid mines. In the west end there is to be the blacksmith shop, iron rack, and drill sharpening shop. This will have an elevator going to the basement which in turn is to be connected to the shaft by a tunnel, so that drills can be brought up from underground and into the shop without becoming frozen. Later the basement will also be connected by another tunnel to the change house which is to be built adjoining the shops on the west; this will permit the miners to go back and forth in their wet clothes without going out in the cold, besides keeping them away from the danger of crossing the loading tracks near the shaft.

A third tunnel will lead from the shaft at this same elevation out to the timber yard, so that the several operations around the shaft collar will not interfere with each other. In the shop building east of the blacksmith shop will be the machine and electrical repair shop, the carpenter shop, the warehouse, and in the east end the laboratory and crusher house. Under the warehouse there is a basement for the storage of heavy supplies and which will be reached by an elevator. The heating plant is contained in a deep basement under the laboratory, and is large enough to take care not only of the shop building but also the change house and engine house which are to be constructed later. A railroad track runs along the north side of the building for its entire length so that supplies can be unloaded directly into any of the shops or warehouse, or coal dumped into the bins of the heating plant. In each shop craneways are provided so that heavy material can be easily handled around the shop or passed on to the next shop. In fact the whole layout is planned for the utmost convenience and efficiency.

Although the No. 4 shaft has just been started the shop building will be completed and equipped as promptly as possible and then the old shops at the Eureka and Asteroid mines will be closed down and all work of the kind concentrated at these new shops.

Gold Placers in Park County, Colo., Increase Activity

New Dredge Planned by Platte River Co.—London Mines Lessees Finish Tram and Mill

Mining in Park County, Colo., has shown a decided improvement during the last few months, the gold placers and gold lode mining companies being the most active.

The Platte River dredge, at Fairplay, has been operated successfully and continuously throughout the year. It is reported that this company contemplates the installation of another large dredge in spring of 1924. This dredge, to be one of the largest in the United States, will be of steel construction. In preparation the company has had a drill in operation for several months proving up and prospecting new beds.

The Allen placer, situated on Tarryall Creek, below Como, has been leased to the Tarryall Mining Syndicate. This syndicate has completed the opening of a coal vein, the production from which will be used to drive the new 200 hp. electric plant, recently installed. This power will be utilized at the placer, 6 miles away, to drive centrifugal amalgamators, with which it is expected to recover both the coarse and fine gold.

The Upper Beaver Creek placer, on Beaver Creek, east of Alma, has been leased to Leadville parties, who expect to start operations as soon as the frost is out of the ground.

Negotiations are now pending for both the Alma and upper Tarryall placers, which, if completed, will mean the resumption of operations on both of these well-known placers.

At Alma, the London Gold Mines Co. now has its new lower tunnel beneath the orebody exposed in the South London workings, and will soon be ready to start stoping. The London Mines Leasing Co., which has a lease on the North and South London workings, is finishing the construction of its new aerial tram and 50-ton mill in North Mosquito Gulch. Concentration, flotation, and cyanide extraction will be used.

The Great West and No-End groups of lode claims, situated on Mount Bross, have been leased to Messrs. Logue and Miller, who expect to start operations soon. They are also operating the Paris and Excelsior properties on Mount Bross.

The Iroquois Mining Co., operating on east end of Loveland Mountain, has developed a large body of low-grade sulphide and a small body of high-grade gold and silver ore.

Will Report Progress in Gold-Silver Inquiry

A progress report, as prescribed by statute, will be made to the Senate Jan. 3 by the Committee of Gold and Silver Inquiry. This report will summarize the more significance facts and information which the commission has gathered since beginning its work.

State of Minnesota Largest Iron Mine Owner

THE State of Minnesota ranks as the largest individual iron mine owner in the country as shown by a report issued by the State Auditor. For the last quarter ending September 30, the state will receive approximately $1,000,000 in royalties from fourteen of its operating properties. The total output of iron ore from state-owned mines for this past season is estimated at 7,000,000 tons, compared with 5,918,985 tons in 1920, which was the largest tonnage shipped heretofore. It has been estimated that the known merchantable ore in the twenty-nine developed and active state-owned mines on Jan. 1, 1922, was approximately 150,000,000 tons. Of this total amount, 190,000,000 tons occurs in properties that were leased on a fifty-year basis, and carry 25c. royalty. This estimate does not include the possible increase of the known tonnage, due to recovering of lean ore by various beneficiation methods.

Real del Monte Mills 3,500 Tons Daily at Pachuca

Electrolytic Refinery for Doré Bullion Works Successfully—San Rafael Plans New Cyanide Plant

The principal companies actively operating in the Pachuca district, in Mexico, are the Real del Monte, Santa Gertrudis, and San Rafael.

The Real del Monte has in operation two cyanide plants of capacity of 2,000 tons and 1,500 tons per day. The company is opening various veins to the south of the Vizcaina fault.

The electrolytic refinery has been put in operation, and at present is handling all Real del Monte doré bars, as well as those produced by other companies. Development of liquid oxygen for blasting purposes continues.

The San Rafael, which for the first time in its fifty years of activity has an American technical staff, reports larger ore reserves and lower costs. This company recently has raised 750,000 pesos with which to complete the installation of a cyanide plant at its mine at San Pedro Analco, Jalisco.

Equipment Added to El Oro Cyanide Plant

The Mexico Mines of El Oro, Ltd., is making much-needed improvements and arranging to handle increased tonnage at its Mexican properties. Paul Avery assumed charge a few months ago. Two additional Burt revolving filters were added to the equipment, and three clarifiers of the Butters type were installed, together with additional pulp storage tanks and new Avery-Shera classifiers.

British Interests Dominant in South Lorrain Silver District

New Rhodesian Mines & Investment Co. Enters Field—Year's Production 3,000,000 Oz. of Silver

It is frequently claimed that the Englishman has been too slow in his participation in northern Ontario mining ventures, and that he has allowed most of the plums to be picked by the Canadians and Americans. There is, however, one field, and that one of the richest, which is controlled by English capital, the South Lorrain silver district, which promises to overshadow Cobalt.

The two big producers, the Keeley and the Mining Corporation, although they have Canadian officers and directors, are controlled by English interests. The Keeley is controlled by the Huronian Belt Co. of London and the Associated Goldfields of Western Australia, and the Huronian Belt has taken over and is operating the old Maidens property, now known as the Canadian Lorrain. Of the capital of the Lorrain Trout Lake, two-thirds is owned by English interests and one-third by the Mining Corporation. The property is being operated under the management of the Mining Corporation, and results of development to date have been exceedingly favorable.

The latest English company to enter the field is the New Rhodesian Mines & Investment Co., which has taken over the control of the Belle Ellen property, which is favorably located ground, believed to have a good deal of promise. Some development was done in the early days of the camp but it is proposed to sink to the contact at about 600 ft., where favorable results are expected. Production from South Lorrain this year should be over 3,000,000 oz., from the Mining Corporation and the Keeley. Results from the district during the past two years or so indicate that it is the richest silver section in the world, the average of all ore mined being over 200 oz. of silver per ton.

New Mexican Company Turns from Anita to Nelly Bly

The effort being made to open the Nelly Bly mine, at old Liedendorf, 8 miles south of Lordsburg, N. M., is moving slowly, due to broken ground. This property, which has not been worked for twenty years by the owners, was taken over recently by the Anita Copper Co. Leasers had left the workings in bad condition, and the work of picking up the old shaft has been slow. Retimbering has been carried to 180 ft. in the main shaft, which is said to be 400 ft. deep. Carl F. Schaber has been put in charge and a further effort will be made to get through the bad ground into the lower workings, which are believed to show good copper sulphides. Work on the Anita mine, formerly the Octo, has been shut down for the purpose, it is said, of waiting returns from the Nelly Bly venture.

Falcon Mines, Ltd., in November

The Falcon Mines, Ltd., operating in Northern Rhodesia, in November crushed 16,638 tons of ore, producing 245,553 tons of blister copper containing 2,286 oz. of gold and 4,502 oz. of silver. The estimated value is £25,602 taking copper at £60 per ton, gold at 92s. 6d. per oz., and silver at 2s. 6d. per oz.

Bootleggers Blamed for Sudbury Bomb Outrage

At about 5 o'clock on the morning of Dec. 21 the house of Police Inspector Ready, of the International Nickel Co.'s police force at Creighton mine, in the Sudbury district, was bombed by unknown persons. The bomb shattered the windows and made a hole in the side of the house. The inspector and his family escaped injury. There has recently been an active campaign against bootleggers, and the outrage is believed to be an act of revenge.

Mohawk May Develop Other Lodes than Kearsarge

Exploratory work on lodes other than the Kearsarge in the Wolverine property in the Michigan copper district is not improbable. Two veins heretofore encountered warrant further investigation. One is opened by a crosscut from the 13th level east and the other from the 28th level west of No. 4 shaft. The showing in the contact in each case is considered promising.

Mohawk, the principal unit of the Mohawk-Wolverine-Michigan combination, eventually will sink two vertical shafts in its new tract of 480 acres of mineral land, carrying the Kearsarge and other lodes, to the west of the Wolverine property. The Kearsarge vein lies deep in this land, but if well mineralized can be mined profitably by resorting to large hoisting capacity, speed in rock handling, driving of long drifts and close selection. There are prospects, too, of finding commercial values in other veins, including the Osceola, in the property.

Seneca Plans to Hoist 4,000 Tons Daily

By early spring, probably March 1, Seneca should be sending fully 700 tons of high-grade rock to the mill from each of its producing shafts, Seneca No. 1 and Gratiot No. 2. Seneca rock is averaging 30 lb. to the ton and it is believed this yield can be maintained. Underground, stopes are being developed well and conditions generally are satisfactory. All drifts are in good ground and the showing in the 7th or bottom level in Seneca No. 1 shaft averages better than any of the upper levels. Sinking will be resumed and the ground opened both north and south of the shaft. Seneca's present hoisting capacity is 4,000 tons per day and eventually it p'ans to reach this tonnage.

London Letter

By W. A. Doman
Special Correspondent

London, Dec. 13—I understand that a most important agreement in connection with the operations of the National Smelting Co. has been signed. This means that producers of zinc concentrates on the Barrier Range, in Australia, the Burma Corporation, the smelting works at Avonmouth and Swansea, and merchants represented by Baldwins, Ltd., are now linked up and can supply the requirements of Great Britain. There is no possibility—at least for several years—of Germany again getting control of the spelter market. Sir Robert Horne, formerly Chancellor of the Exchequer, is to be chairman of the company, and the other principals will be Sir Cecil L. Budd, Sir John Davies, F. A. Govett, Captain Oliver Littleton, S. C. Magennis, W. S. Robinson and Sir John Roper Wright. W. S. Robinson represents the Zinc Producers' Association Proprietary, the Electrolytic Zinc Co., of Australasia, and many other mining companies in that part of the world.

Optimistic Opinion of Government Areas

An engineer formerly occupying an important position on the Rand has given his views as to the value of Government Gold Mining Areas. In brief, he says, the reef being flat, shaft sinking expenditure is at a minimum. The property is surrounded by profitable mines, such as Brakpan, Modder Deep, Modder B, and Geduld, and may be regarded as proved throughout. The 2,600 claims are being exhausted at the rate of 45 per annum, and with falling costs the percentage payable should be between 60 and 70 per cent, giving a productive life of another quarter of a century. Increased reduction plant will raise the monthly capacity to 200,000 tons, and the profit to £2,500,000 annually, allowing of a dividend of 80 per cent. The government takes the bulk of the risk of higher costs and lower grade, and the mine is exempt from taxation under the Gold Law. This being so, the value of the share on a 7 per cent basis is £8 10s., taking the annuity for twenty years.

Copper from Venezuela

The South American Copper Syndicate (Venezuela) shipped in the twelve months ended June 30 last, 3,473 tons of matte of 19.1 per cent average copper content and 1,264 tons of crude ore averaging 8.8 per cent copper, realizing 14.12c. (United States currency) per lb. of copper. The first furnace of the new smelting plant was not started up until December, so that there is a debit balance at profit-and-loss account of £20,536. This is written off out of share premium account. At June 30 it was estimated that 39,000 tons of ore averaging 6 per cent copper had been put in sight.

Owing to reports of heavy consumption of the metal in the states and the belief that the price would rise almost uninterruptedly, speculation in tin has been rampant. A setback of about £8 per ton scared operators who endeavored to sell, and the consequences in some cases have been disastrous.

Porcupine Midfield Gold Mines?

Rowland C. Feilding has written a report on the Porcupine Midfield Gold Mines. It is by no mean flattering, and how the directors who hail from Toronto can imagine it will draw British capital is beyond comprehension. Rowland Feilding appears to be rather uncomfortable at the use made of the report, as the Porcupine Midfield people are flooding the country with circulars. There is, however, no harm done so far as he is concerned, though it is not pleasant to be associated with an undertaking in connection with which circularizing methods—generally open to criticism—are adopted.

Senator Pittman Insists on Investigation of War Minerals Relief

Alleges Inequities in Awards—Whole Administration Will Be Probed—Delay Criticized

By Paul Wooton
Washington Correspondent

The insistence of Senator Pittman, of Nevada, that the administration of the War Minerals Act be investigated promises to precipitate all matters coming under that head, shortly after the reconvening of Congress after the holiday recess. Senator Pittman is concerned principally in certain alleged inequities in findings under the act. It is stated that disallowances have been ordered in certain instances where exactly the same principles apply on which awards were granted in other claims.

There is no suggestion that deliberate favoritism has been shown to any claimant. It is thought, however, that the dwindling appropriation prompted the denial of many claims where the applicants were entitled to awards fully as much as were those considered at an earlier period.

The opening of any investigation of the War Minerals Relief administration is certain to give rise to consideration of a general investigation of the situation, particularly that dealing with the handling of the remaining appropriation. There is some objection to the policy of the Secretary of the Interior in withholding awards on the possibility that the Attorney General may rule that the making of ferromanganese is simply a method of rendering ore marketable, thereby bringing within the scope of the act the large claim of the Anaconda Copper Mining Co. and eleven other claims, carrying a sizeable aggregate which comes within the same category. Similar possibilities which influenced the Secretary to halt awards arise from expected court rulings which may hold purchase of property and interest payments to be allowable losses.

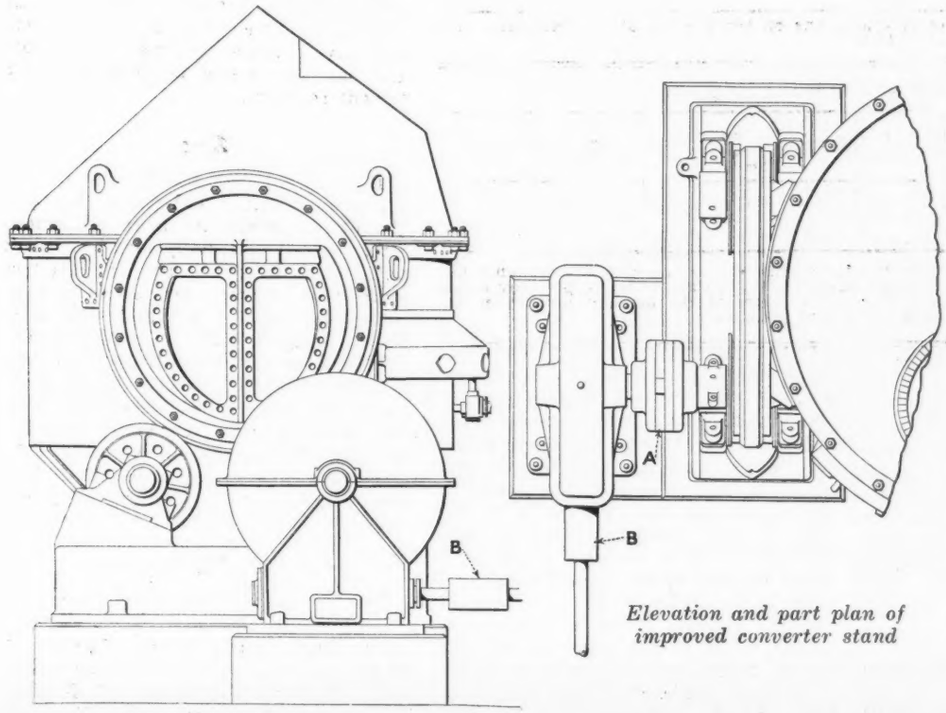
New Machinery and Inventions

Improved Copper Converter Stand Installed by United Verde

The modern copper converter stand consists of two heavy castings which support four rollers that carry the weight of the converter. One of the rollers is a pinion which rotates the converter into the charging, blowing, and discharging positions. The pinion shaft is connected to a worm gear which is driven by a back-geared motor. Considerable difficulty has been experienced with the usual arrangement because of the end thrust which sometimes comes from the pinion shaft. The drive is also difficult to dismantle. An improvement in design has recently been worked out and a converter stand of the new type has been installed at the United Verde smelter at Clarkdale, Ariz., by the Allis-Chalmers Co. The pedestals of the bearing boxes used for supporting the roller shafts are inclined at an angle of about 23 deg. above the horizontal. This permits the full downward thrust to be taken up by the lower half of each bearing. The bearing boxes are provided with cast-iron bushings, the bushings for the pinion bearings being split. The bushings are bored for the introduction of lubricants, and face-plates attached by stud bolts are used to confine the lubricant to the bearing. It is expected that forced lubricant will eliminate lubrication troubles by securing a uniform distribution of the lubricant.

A rolling mill type of coupling, *A*, is interposed between the outside pinion box and the worm gear. This relieves the worm gear from all end thrust. The driving shaft of the worm gear is divided by a sleeve coupling, *B*, which is keyed and bolted to the worm shaft projecting from the gear case. The other end of the coupling is provided with a deep square recess to receive the square end of the shaft. This allows about an inch play between the end of the shaft and the bottom of the recess. The shaft is attached to the motor shaft by an ordinary coupling. A 50-hp. back-geared motor with solenoid brake is used for turning the converter.

The arrangement described not only relieves the worm gear of all thrusts from either the pinion or driving shafts but makes dismantling easy.

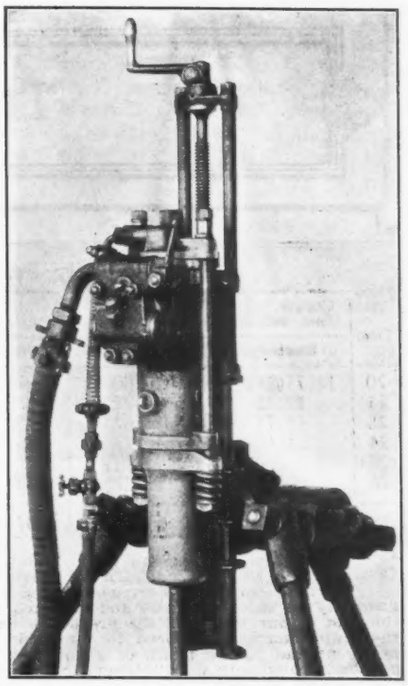


Elevation and part plan of improved converter stand

New Drill Gives 60 Per Cent More Footage

A new compressed-air operated hammer drill, which will take the place of the old piston-type machine for drilling the deep holes required in quarry work, has been announced by the Ingersoll-Rand Co., 11 Broadway, New York.

Since the introduction of the piston drill, about fifty years ago, there have been few improvements in the method of putting down deep holes, except improvements in the design and material of the piston type drill itself and the gradual substitution of compressed-air power for steam. This new drill, the X-70 Leyner Ingersoll drifter, will, according to the manufacturer, increase the daily footage over the piston drill at least 60 per cent. It is essentially a deep-hole machine and its greatest field is, perhaps, in quarry and tunnel work, where holes from 20 ft. to 35 ft. are drilled. It is not restricted to this field, however, as it is being used for mining and excavating where exceptionally hard rock is met, or deep holes are required.



A new drill for deep holes

In a mine in Newfoundland this machine accounted for 245 ft. of hole in six hours. An average footage of five other different mounted hammer drills in this mine operating under similar conditions on the same day was 137. Other tests gave equal satisfaction.

Some of the features claimed for the drill are:

It can be operated satisfactorily with or without water, thereby eliminating the chances of pipe lines freezing, if used in a cold country. All-steel drop forge construction gives it simplicity and ruggedness, with corresponding low upkeep cost. Its powerful Sergeant rifle-bar rotation eliminates trouble from stuck steel and makes it desirable in broken or fitchery ground. For deep hole work requiring hole cleaning ability, a special feature makes it possible to draw air from the air chest and send it continually down the hollow steel to the bottom of the drill hole.

The drill weighs 207 lb. when equipped with a 24-in. feed shell, and 210 lb. with a 30-in. feed shell. It fits a tripod with a 5-in. cone saddle. The drill steel used is 1¼-in. hollow round with standard Leyner lug shanks.

Simplicity and ease of operation, together with rugged construction and ability to stay on the job are important features.

THE MARKET REPORT

Daily Prices of Metals

Dec.	Copper, N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
20	12.75@12.875	46.00	46.50	7.45	7.50	6.25
21	12.75	46.75	47.25	7.45	7.50	6 25
22	12.75	46.625	47.125	7.45	7.50	6.25@6.30
24	12.75	46.75	47.25	7.45	7.50@7.75	6.25@6.30
25	.....	.....	.....	....	.....	.....
26	12.75	46.875	47.375	7.45	7.50@7.75	6.25@6.30
Av.	12 763	46.600	47.100	7.450	7.550	6.265

*These prices correspond to the following quotations for copper delivered: Dec. 20th, 13.00@13.125c.; 21st, 22nd, 24th, and 26th, 13.00c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

Dec.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
20	61¾	62⅝	67¾	230½	232½	30½	29⅞	32⅞	33
21	61½	62¼	67½	235	236½	30⅝	29¾	32⅝	33
24	...	...	...	....	....	...	...	...	..
25	...	...	...	....	....	...	...	...	..
26	...	...	...	....	....	...	...	...	..

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Dec.	Sterling Exchange "Checks"	Silver		Gold London	Dec.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
20	4.36	64	33 1/16	94s 6d	24	4.34	64⅜	33 9/16	95s 1d
21	4.35	64⅜	33⅜	94s 7d	25	....	...	....	.. ..
22	4.34	64⅜	33½	.....	26	4.34	64½	....	.. ..

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Metal Markets

New York, Dec. 26, 1923

As was to be expected the metal markets have been exceedingly quiet all week and this inactivity is expected to continue until after New Year's day. Copper is fractionally weaker; tin substantially unchanged; and lead and zinc slightly higher in price than last week.

Copper

Practically no orders for copper have been placed all week, though it is reported that some fabricators have booked business which they have not yet covered in purchase of crude copper. In two or three directions it has been possible to buy at 13c., delivered, a fairly large tonnage being available today at that level, and for delivery over the next two months. Most of the producers are holding at either 13⅛c. or 13¼c. but admit that business at those levels is confined to an occasional carload where special considerations apply. This range could not be shaded, however, for second-quarter copper, which is obtainable in only one or two directions. Today, some offers have been made at slight reductions from the 13c. delivered level but only to where favorable freight rates apply.

Export demand has also been quiet, though a little business filters in each day.

Lead

The official contract price of the American Smelting & Refining Co. continues at 7.40c., New York.

The position of lead continues substantially unchanged from that reported a week ago. Lead for shipment within the next month is virtually unobtainable and prices up to 8¼c. New York are quoted. The amount of metal passing at premium prices is, however, negligible. Most consumers seem to be well taken care of, for inquiries have not been numerous. In the Middle West, the situation is equally tight and lead has been sold in small quantities during the week at various prices from 7½ to 7⅝c., the higher price being realized on two or three orders placed on Monday, though some producers were still selling to preferred customers at the lower level.

At least one important producer feels that the market has about reached the top and that the fancy prices now asked for prompt lead will soon collapse to the level at which most of the metal has actually been sold during the last two or three weeks. Consumption continues excellent but it is felt that present prices will stimulate enough additional production to take care of the demand, and that further increased prices are not justified. Certainly, all producers have adopted a most conservative attitude, fearing that an undue inflation would be followed by a violent reaction.

Zinc

Demand has been fair for zinc during the week, possibly better than that for the other metals. As a result, prices strengthened materially last Thursday. and the advance has been maintained since, with prompt and January zinc selling for about 6.25c., and February-March bringing 6.30c. On high-grade, the price continues at from 8 to 8⅛c. delivered. The domestic market is quiet, but some excellent orders have been placed abroad. On last Thursday, 500 tons of brass special was sold, this being the first good order that has been placed for this grade for some time.

Tin

The tin market has been generally quiet, though business has not been non-existent by any means. The price of 99 per cent grade continues nominal. Forward deliveries of Straits have recently been quoted at a discount of about ¼c. from the price of spot.

Foreign Exchange

On Monday, Dec. 24, cable quotations on francs were 5.08c.; lire, 4.3325c.; and Canadian dollars, 2½ per cent discount. French francs registered a new low during the week.

Circulation Statement

According to the U. S. Treasury Department, the stock of money in the United States on Dec. 1 was as follows: Gold coin and bullion, $4,209,634,641; standard silver dollars, $497,863,769; subsidiary silver, $274,269,786; United States notes, $346,681,016; Federal Reserve notes, $2,719,744,770; Federal Reserve Bank notes, $15,279,170; National Bank notes, $773,435,044; total, $8,836,908,196. In circulation, per capita, $44.01. Gold stocks increased $41,000,000 during November, and outstanding notes decreased about $1,000,000.

Silver

After the decline of last week prices rallied on the strength of renewed orders from India; the market is quiet, however, on account of the Christmas holidays.

Mexican Dollars—Dec. 20th, 48⅞; 21st, 49⅛; 22d, 49⅛; 24th, 49⅛; 26th, 49¼.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum — 99 per cent grade, 27c. per lb.; 98 per cent, 26c. London, £115 per long ton.

Antimony — Chinese and Japanese brands, 9¼@10⅜c. W.C.C. brand, 10½@11c. Cookson's "C" grade, 11¼@11½c. Chinese needle antimony, lump, nominal, 6½@7½c. per lb. Standard powdered needle antimony (200 mesh), 7½@8½c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, 7.50c.

Bismuth—$2.55 per lb. London, 10s.

Cadmium—75@80c. per lb. London, 2s. 6d.

Cobalt—$3 per lb. for spot.

Iridium—$275@$300 per oz.

Nickel—27@30c. per lb. for 99 per cent virgin metal. London, £130 long ton.

Palladium—$83 per oz.

Platinum—$125 per oz. London, £29.

Quicksilver — $60 per 75-lb. flask. Quiet. San Francisco wires $59.35. London, £9 15s.

The prices of Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Selenium, Tellurium, Thallium, and Tungsten are unchanged from prices given Dec. 8.

Metallic Ores

Chrome — $19.25@$22, depending upon grade and source. Nominal.

Manganese—38@42c. per long ton unit, seaport, plus duty. Nominal.

Molybdenum—80c. per lb. of MoS_2 for 85 per cent concentrates. Nominal.

Tantalum—Foreign, 60c. per lb. of Ta_2O_5 contained, c.i.f. New York. Contains about 65 per cent Ta_2O_5 and 5 per cent Cb_2O_5.

Domestic grades offered at 90c. per lb. of contained Ta_2O_5. Contains about 54 per cent Ta_2O_5 and 24 per cent Cb_2O_5.

Market limited. Last importations made in March.

Tungsten Ore—High-grade wolframite, $9; high-grade scheelite, $9.50@$10 per unit. Ordinary grades, $8.15@$8.50.

Vanadium—Minimum 50 per cent V_2O_5, $1@$1.25 per lb. Nominal.

Iron Ore, Magnetite, Titanium, and **Zircon Ore** are unchanged from the quotations published Dec. 8.

Zinc and Lead Ore Markets

Joplin, Mo., Dec. 22—Zinc blende, per ton, high, $44.75; basis 60 per cent zinc, premium, $42; Prime Western, $41; fines and slimes, $40@$38; average settling price, all zinc ore, $40.56.

Lead, high, $105.40; basis 80 per cent lead, $105; average settling price, all lead ore, $98.93 per ton.

Shipments for the week: Blende, 16,287; lead, 1,722 tons. Value, all ores the week, $834,970.

Practically all mines will remain closed down all of next week, and many have given the miners a two weeks' vacation. Purchases were 13,810 tons, but the smelters have upward of 25,000 tons of ore in bins upon which advance payments have been made and sellers are crowding them to load it out to avoid the Oklahoma assessment falling on Dec. 31.

Platteville, Wis., Dec. 22.—Blende, basis 60 per cent zinc, $44 per ton. Lead, basis 80 per cent lead, $102 per ton. Shipments for the week: Blende, 662 tons; lead, none. Shipments for the year: Blende, 31,554; lead 750 tons. Shipments for the week to separating plants, 1,103 tons blende.

Non-Metallic Minerals

Asbestos—Crude No. 1, $350@$450; No. 2, $200@$250; spinning fibers, $100@$125; magnesia and compressed sheet fibers, $60@$90; shingle stock, $50@$60; paper stock $30@$40; cement stock, $17@$20; floats, $6@$12. All f.o.b. mines, per short ton, Quebec.

Feldspar—No. 1, $6.60 per long ton, f.o.b. cars; No. 2, $4.50; ground spar, glass trade, $10, f.o.b. mill; pottery grade, $18 per long ton, North Carolina points.

No. 1, not carrying in excess of 10 per cent SiO_2, $7.90 per ton, f.o.b. New Hampshire points.

For other feldspar quotations see issue of Dec. 8th.

Mica—Scrap, $20 per ton; washer, 11c. per lb.; disk, 1½ in., 30c. per lb.; 2x2 in., 55c.; 2x3 in., 80c.; 3x4 in., $1.05; 3x5 in., $1.60; 4x6 in., $2 per lb., North Carolina mines.

Ground mica, 60 mesh, $65 per ton; 80 mesh, $70; 120 mesh, $120; 140 mesh, $125; all f.o.b. North Carolina mills.

Washer and disk mica, $280 per ton; scrap $25 per ton, f.o.b. New Hampshire points. Demand greater than supply.

Barytes, Bauxite, Beryl, Borax, Chalk, China Clay, Diatomaceous Earth, Emery, Fluorspar, Fuller's Earth, Garnet, Graphite, Gypsum, Limestone, Magnesite, Manjak, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur, Talc and Tripoli are unchanged from the Dec. 8 prices.

Mineral Products

Arsenious Oxide (white arsenic)—13½c. per lb.

Copper Sulphate—4.75@4.90c. per lb., domestic product.

Potassium Sulphate—Basis 90 per cent, $45.85 per ton.

Sodium Sulphate—$24@$26 per ton, New York.

Sodium Nitrate—$2.45 per 100 lb., ex vessel.

Ferro-Alloys

Ferromanganese — Domestic, 78@82 per cent, generally obtainable at $109 per gross ton, f.o.b. works. Spiegeleisen, 19@21 per cent, $40; 16@19 per cent, $39.

Ferrosilicon—50 per cent, reduced to $75 per gross ton, delivered.

Ferrotungsten—85@90c. per lb. of contained W.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrotitanium, Ferrouranium and **Ferrovanadium** are unchanged from the prices published Dec. 8.

Metal Products

Copper—Sheets, 21c. base; wire, 15⅝c.

Lead Sheets—Cut, 10.50c.; full, 10.25c. per lb.

Nickel Silver—18 per cent Grade A sheets, 28c.

Yellow Metal — Dimension sheets, 18.75c.; rods, 15.75c.

Zinc Sheets—Base price, $9.25 per 100 lb., f.o.b. plant.

Refractories

Bauxite Brick, Chrome Brick, Firebrick, Magnesite Brick, Magnesite Cement, Silica Brick and Zirkite are unchanged from the Dec. 8 prices.

The Iron Trade

Pittsburgh, Dec. 24, 1923

Shading in sheets has been gradually diminishing for weeks until now it is relatively insignificant, and the sheet market can be quoted again at full prices, 3c. for blue annealed, 3.85c. for black, 5c. for galvanized sheets and 5.53c. for automobile sheets.

Pig Iron—Market dull. Foundry firm at $22 to $22.50; bessemer at $23, Valley, is but little tested, and the asking price of $21, Valley, on basic iron is doubtful of realization.

Connellsville Coke—At least two first-quarter furnace-coke contracts have gone at the unexpectedly low price of $3.75. An early contract at $4.40 is seen to have had no influence in making the market. Spot coke failed to have its usual holiday advance, being $3.75@$4 for furnace and $5@$5.50 for foundry.

Company Reports

Burma Corporation

In consequence of a decision to change the Burma Corporation's financial year, the report for the year 1922 is supplemented by a further report bringing the record of the company's affairs up to the end of June, 1923.

During the eighteen months substantial increase in the production of metals is shown in the following table:

	Ore Milled, Tons	Production: Refined Lead, Tons	Silver, Oz.	Zinc Concentrates Tons
1920	128,908	23,821	2,869,727	...
1921	149,724	33,694	3,540,812	...
1922	195,008	39,213	4,191,819	...
1923 (a)	127,360	21,654	2,266,874	855

(a) To June 30.

The accounts for 1922 and for the first half of 1923 are shown separately. During 1922 the surplus was £169,209 over the corresponding figure for 1921, and the results of the half-year to June 30, 1923, showed a further expansion in the profits. The success met with has enabled the directors to make a start with the payment of dividends, the first of 4 annas per share, free of Indian income tax, having been paid last August, while a similar dividend will be paid in February next.

The financial results of the last two and a half years are as follows:

	(Jan.-June) 1923 £	1922 £	1921 £
Lead and silver sales and on hand	936,242	1,699,383	1,386,828
Sundry revenue	31,305	37,911	22,972
	967,574	1,737,294	1,409,800
Operating expenditure, including development	527,215	1,030,112	865,899
Head office and sundry expenditure	28,256	40,166	46,094
Surplus	412,076	667,016	497,807
	967,547	1,737,294	1,409,800
Allocations of surplus			
Interest on debentures	38,052	78,993	77,586
Depreciation	71,528	128,814	137,019
Income and super taxes	43,912	75,735	49,103
Reserve fund	50,000	100,000	66,667
Balance, net profit	208,584	283,474	167,432
	412,076	667,016	497,807

Many extensions and improvements have been made in the plant, with the result that the metal recoveries have been higher and the costs of production reduced. The 700 tons per day program, which was adopted some time ago when larger plans were temporarily set aside, has now nearly been carried out, the daily output for the first six months of 1923 having been 655 tons.

The ore-reserve figures are tabulated below.

	Tons	Lead, Per Cent	Zinc, Per Cent	Silver, Oz.
Jan. 1, 1922	4,290,358	25.1	17.5	23.0
Jan. 1, 1923	4,555,069	25.4	17.1	22.9
July 1, 1923	4,511,909	25.3	16.9	22.8

These tonnages include 335,681 tons of silver-lead-zinc ore containing 11 per cent of copper. During the first six months of 1923, 855 tons of zinc concentrates was produced.

The labor position, which in the past has been a matter of difficulty and anxiety, is reported as being much improved. Much attention is being paid to getting more efficiency, so as to economize in numbers, and with this objcet in view the European staff at the mine has been strengthened. The importance of making the housing and general living conditions as attractive as possible has not been ignored, and the expenditure made in this direction is meeting its reward. The transport difficulty has not been entirely solved, and no definite agreement has as yet been come to with Burma Railways as regards the extension of the line to Namtu. Meanwhile the company is arranging for improving its own railway to enable it to deal with the increasing traffic.

The balance sheet of the report is made out in rupees.

June 30, 1923

Liabilities	Rs.	Assets	Rs.
Share capital	13,54,16,890	Property	12,73,08,799
Debentures	1,00,00,000	Smelter	98,70,217
Creditors	42,87,179	Railway	25,34,980
Exchange suspense account	4,71,726	Mine	12,57,486
Reserve fund	59,64,699	Stores	49,15,753
Profit or loss	1,25,93,918	Lead, silver	19,26,605
		Debtors	31,06,435
		Investments	1,05,64,626
		Balance at bankers and cash	72,49,511
	16,87,34,412		16,87,34,412

Tomboy Gold Mines Co., Ltd.

Gold; Telluride, Colo.

A report of the operations of the Tomboy Gold Mines Co., Ltd., for the year ended June 30, 1923, shows a realized profit of £36,275 7s. 4d., but there has to be provided for depreciation £16,128 16s. 7d., and for British taxation £6,000, leaving a credit balance of £14,146 10s. 9d.; deducting from this £1,650 18s. 6d., the debit balance brought forward from last year leaves a balance to credit of profit-and-loss account of £12,495 12s. 3d.

The milling results for the period show that 206,146 tons of ore has been milled, yielding $940,214.15, and that costs amount to $774,476.63, leaving a profit of $165,737.52. If the item of sundry profits, $10,002.71, is added to this, the total amounts to $175,740.23.

The working costs for the year at the mine were $3.76 per ton.

In view of the discouraging results of development work during the year under review, and even more so in the last few months, the board of directors has had to consider most seriously what is the best policy to be adopted. Shareholders are informed that the manager's advice is to proceed to reduce expenses as much as possible, concentrate on drawing and milling what pay ore remains, and to continue to operate only as long as a profit can be made.

A total gross of 233,114.4 tons was hauled from the mines to the mill in the period covered by the report. From this total 14,769.3 tons, or 6.33 per cent, was sorted out and discarded as waste, and 12,314.8 tons, or 5.63 per cent, deducted for moisture content, leaving, with a loss in bin storage of 115.7 tons, a net total of 206,146 dry tons milled.

Revenue and Expenditure

Year to June 30, 1923

	Per Ton	Total	
206,146 dry tons milled, yielding bullion worth			$248,598.64
Concentrates			691,615.51
			$940,214.15
Sundry profit, boarding house and rents			10,002.71
Total			$950,216.86
Mining and development expenses	$1.80	$370,853.47	
Milling expenses	0.59	122,369.57	
Concentrating expenses (including transportation to railway)	0.66	135,991.34	
Water-supply expenses	0.18	37,389.18	
Assay-office expenses	0.03	6,103.27	
General expenses	0.32	64,288.26	
Taxes and insurance	0.18	37,481.54	
			$774,476.63
Total expense	$3.76		
Profit			$175,740.23

The Santa Gertrudis Co., Ltd.

Gold, Silver; Pachuca, Mexico

The general manager's report on the working operations of the Santa Gertrudis mines for the quarter from July 1 to Sept. 30, 1923, states that the mill crushed 29,084 dry short tons of ore from the Santa Gertrudis mine. The value of bullion produced was $227,821, in United States currency. Working expenses (including development and shipping and selling), were $157,264 and the estimated profit at the mines was $70,557. In addition to the tonnage above noted, the mill crushed 119,672 dry short tons of ore, delivered by the Inversiones company from its El Bordo, Malinche, and El Cristo mines, and the Dos Carlos company, from its Dos Carlos and Refugio y Virginia mines.

Lena Goldfields, Ltd.

Gold; Siberia

A report of the Lena Goldfields, Ltd., for a period covering the four years from Oct. 1, 1919, to Sept. 30, 1923, states that the shareholders will recall that at the extraordinary general meeting held on Oct. 4, 1922, the reasons for taking power to increase the capital of the company were explained. Since that date, following the policy outlined at that meeting, considerable progress has been made in securing the collaboration of the other large interests which are so important to the contemplated arrangement with the Soviet Government, and it will now be necessary to ask the indorsement of the shareholders of the policy pursued before the scheme can be further advanced. To carry out this policy the company entered into an agreement on Nov. 3, 1922, with the Anglo-Russian Industries Corporation, Ltd., whereby it has been possible to consolidate and control the enterprises in which the company was largely interested, and also other important mining enterprises in Russia. Provision has been inserted in the abovementioned agreement that before it should be binding on this company it should be submitted for approval to the shareholders, as, to secure the above objects, advances in some cases have been made to or in connection with companies in which some of the directors were interested.

The concession asked for covers the properties of all of these enterprises, and the directors state that in the event of a satisfactory arrangement being concluded with the Soviet Government, an agreement with a strong Anglo-American group has been made for the provision of the large working capital necessary to restart and work the enterprises. The Soviet Government in Moscow has been furnished with the general outline of these proposals and the details of the properties included in the consolidation, and the company's representatives are now on their way to Moscow with a view to negotiating an agreement.

Belgian Zinc Production

The production of zinc in Belgium since the beginning of 1920 is given by months in the following table in tons of 2240 lb.

Belgian Zinc Production 1920-1923

	1923	1922	1921	1920
January	10,650	8,250	8,310	4,060
February	11,340	7,750	6,530	4,560
March	12,990	8,950	4,640	5,841
April	12,610	8,490	4,320	6,540
May	12,240	8,830	4,360	7,370
June	12,010	8,310	4,370	7,250
July	11,960	8,960	4,950	7,400
August	11,975	9,640	5,000	7,650
September	11,950	9,870	4,990	7,695
October	12,670	11,007	5,460	8,170
November	12,890	11,250	6,170	8,020
December	.....	11,130	7,370	8,490
Totals	.....	112,437	66,470	83,046

U. S. Smelting Underwrites Hammon Goldfields

Announcement was made in Boston recently that the U. S. Smelting, Refining & Mining Co. will underwrite, at par, 7 per cent convertible notes of the Hammon Consolidated Goldfields, of Nome, Alaska, due Jan. 1, 1934, to the amount of $1,500,000. These notes are convertible into stock at $10 a share. The Smelting company gets a bonus of 50,000 shares of stock, and underwrites the notes at the same price as that at which they are to be offered to stockholders.

German Barytes Exported to the U. S.

Recent shipments of barytes have been made to the United States from Thuringian mines, according to *Commerce Reports*. Heretofore these shipments went to England, but the demand there has fallen off. Germans are anticipating large business from the United States.

Facts for the Stockholder

XXXI—Mother Lode Coalition Mines Co.

MOTHER LODE COALITION MINES CO. was incorporated in Delaware, in April, 1919, and acquired the properties and business of the Mother Lode Copper Mines Co. of Alaska. It is controlled by the Kennecott Copper Corporation interests through ownership of 51 per cent of the stock.

The property includes about 100 lode and placer claims, with an area of about 1,640 acres, in the Copper River district, adjoining the Bonanza mine of the Kennecott Copper Corporation; also twelve lode claims and one association placer mining claim.

The mine is connected with the Bonanza mine of the Kennecott Copper Corporation by two tunnels. Mother Lode ore is hoisted from the Bonanza mine and carried over the Kennecott rope tramway to the mill at Kennecott. Electric haulage is used underground. The high-grade ore is shipped direct to Cordova, and thence by steamer to the smelter at Tacoma. The low-grade ores are concentrated in the Kennecott mill and then shipped to Tacoma.

The Kennecott Copper Corporation has contracted to take 12,000 tons of Mother Lode ore per month for treatment at its mill, at cost, until Dec. 31, 1928. The American Smelting & Refining Co. has agreed to purchase at the market, up to Dec. 31, 1923, all or such part of the production as the Mother Lode Coalition Mines Co. shall require it to take.

The charter provides that the directors may make or rescind by-laws without assent of the stockholders, may fix the amount to be reserved as working capital, and may execute debentures, mortgages or liens on any property of the corporation. They may also convey without assent of the stockholders any interest less than the whole, or substantially the whole of the assets of the company. Voting power for election of directors is cumulative, each share of stock being entitled to as many votes as there are directors to be elected.

The company mined 72,457 tons of ore in 1920, 76,993 tons in 1921, and 98,802 tons in 1922. Of the 1922 production, 12,220 tons was high-grade ore assaying 62.71 per cent copper and 9.34 oz. silver a ton. This was shipped direct to the smelter, and 86,582 tons assaying 6.85 per cent copper and 1.04 oz. silver a ton was sent to the Kennecott mill. At the mill, 9,671 tons of concentrate assaying 48.88 per cent copper and 7.47 oz. silver a ton was recovered and shipped to the smelter, showing a mill recovery of 79.65 per cent of the copper and 79.76 per cent of the silver.

Production of copper in millions of pounds has been: 4.8 in 1919, 17.5 in 1920, 18.9 in 1921, and 24.6 in 1922.

Cost of producing copper, after interest, depreciation, and taxes, and crediting silver, was as follows: 9.9c. a pound in 1919, 8.66c. in 1920, 7.60c. in 1921, and 6.9c. in 1922.

Capital stock consists of 2,500,000 shares of no par value, of which 1,150,600 shares are owned by the Alaska Development & Mineral Co., all of the stock of which is owned by Kennecott Copper Corporation. There is no funded debt. The stock was listed on the New York Stock Exchange on Aug. 9, 1922.

Earnings per share have been: 10c. in 1919, 46c. in 1920, 40c. in 1921, and 66c. in 1922. These earnings are before depletion, which has been charged off at $1,300,601 in 1920 $1,660,939 in 1921, and $1,926,658 in 1922, leaving corresponding deficits of $42,214 in 1920, $657,266 in 1921, and $272,250 in 1922.

On Dec. 31, 1922, current assets were $1,317,507, against current liabilities of $448,154, leaving net working capital at $869,353, compared to $1,606,158 in 1921 and $1,486,931 in 1920. Net assets applicable to the stock are estimated at $5.32 a share, compared to $6.43 a share in 1921.

The present dividend rate is $1 a share per annum, payable semi-annually. The initial dividend of 50c. a share was paid June 30, 1922, $1 being paid during 1922.

Price range of the stock has been: High, 14 in February, 1923; low, 7⅛ in June, 1923; closing price 8, Dec. 24, 1923.

INVESTIGATOR.

MINING STOCKS

Week Ended December 22, 1923

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	...	...	50	June 23, Q	$1.50
Alaska-Br. Col.	N. Y. Curb	...	...	*50	.....	....
Allouez	Boston	...	...	*16	Mar. '19	1.00
Anaconda	New York	37⅞	36	36	De.15, Ja.21, Q	0.75
Arcadian Consol.	Boston	...	...	2½	.....	....
Ariz. Com'l	Boston	7½	7½	7½	July '23,	0.50
Calaveras	N. Y. Curb	....	....	1⅜	.....	....
Calumet & Arizona	Boston	...	...	43¾	De.7, De.24, Q	0.50
Cal. & Hecla (New)	Boston	18⅞	18¾	18⅞	De. 1, De. 17	0.50
Centennial	Boston	...	...	7	Dec. '18, SA	1.00
Cerro de Pasco	New York	46¾	44½	44⅝	Oc.18, No.1, Q	1.00
Chile Copper	New York	27¾	27	27⅛	De.1, De.29, Q	0.62½
Chino	New York	17⅞	17	17⅜	Sept. '20, Q	0.37½
Con. Cop.Min.(New)	N. Y. Curb	1⅛	1 1/16	1⅛	.....	....
Copper Range	Boston	23	23	23	May '23, Q	1.00
Crystal Copper	Boston Curb	75	69	74	.....	....
Davis-Daly	Boston	...	...	3½	Mar. '20, Q	0.25
East Butte	Boston	4⅜	4⅜	4⅜	Dec. '19, A	0.50
First National	Boston Curb	36	30	30	Feb. '19, SA	0.15
Franklin	Boston	*99	*99	*99	.....	....
Gadsden Copper	Boston Curb	*42	*35	*40	.....	....
Granby Consol.	New York	15⅝	14	14	May '19, Q	1.25
Greene-Cananea	New York	15	13⅝	13⅞	Nov. '20, Q	0.50
Hancock	Boston	...	...	1⅞	.....	....
Howe Sound	N. Y. Curb	2⅛	2⅛	2⅛	Ja.2, Ja.15	0.05
Inspiration Consol.	New York	26⅜	24¼	24½	De. 20, Ja. 7, Q	0.50
Iron Cap	Boston Curb	3½	3½	3½	May 23, K	0.15
Isle Royale	Boston	...	...	18½	Se. 1, Se. 15,	0.50
Kennecott	New York	34⅜	33¼	33⅛	De. 7, Ja. 2, Q	0.75
Keweenaw	Boston	...	...	*85	.....	....
Lake Copper	Boston	1	1	1	.....	....
Magma Copper	New York	30½	29½	30	Jan. '19, Q	0.50
Mason Valley	N. Y. Curb	1⅝	1⅝	1⅝	.....	....
Mass Consolidated	Boston	...	...	*99	Nov. '17, Q	1.00
Miami Copper	New York	22¼	21⅛	21⅛	No. 1, No. 15, Q	0.50
Michigan	Boston	...	...	1⅜	.....	....
Mohawk	Boston	...	...	*34½	Se. 22, Oc. 13,	1.00
Mother Lode Coa.	New York	8¾	8	8	De.14, De.31	0.50
Nevada Consol.	New York	12	11¾	11¾	Sept. '20, Q	0.25
New Cornelia	Boston	*16	*16	*16	Au. 3, Au. 20, Q	0.25
New Dominion	N. Y. Curb	2½	2⅜	2⅜	.....	....
North Butte	Boston	...	...	2½	Oct. '18, Q	0.25
Ohio Copper	N. Y. Curb	*81	*76	*77	.....	....
Old Dominion	Boston	16½	16½	16½	Dec. '18, Q	1.00
Osceola	Boston	...	...	31½	June '23, Q	1.00
Phelps Dodge	Open Mar.	†148	†138	....	De.20, Ja. 2 Q	1.00
Quincy	Boston	20½	20	20	Mar. '20, Q	1.00
Ray Consolidated	New York	11⅛	11	11⅛	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	*21	*21	*21	.....	....
St. Mary's Min. Ld.	Boston	...	...	*32½	No.9, De.11, K	1.00
Seneca Copper	New York	6¼	5	5⅛	.....	....
Shannon	Boston	*40	*40	*40	Nov. '17, Q	0.25
Shattuck Arizona	New York	6⅞	6½	6¾	Jan. '20, Q	0.25
South Lake	Boston	...	...	¾	.....	....
Superior & Boston	Boston	...	...	1⅛	.....	....
Tenn. C. & C. cfs.	New York	9½	9	9⅛	De.31, Ja.15, Q	0.25
Tuolumne	Boston	*40	*40	*40	May '13,	0.10
United Verde Ex.	N. Y. Curb	27¼	26½	27	Ja.1, Fe.1, Q	1.00
Utah Consol.	Boston	*1	*1	*1	Sept '18,	0.25
Utah Copper	New York	64¼	63¼	63⅜	De.3, De.15, Q	1.00
Utah Metal & T.	Boston	*30	*25	*30	Dec. '17,	0.30
Victoria	Boston	*70	*70	*70	.....	....
Winona	Boston	...	...	*15	.....	....
Wolverine	Boston	...	...	5⅛	.....	....
NICKEL-COPPER						
Internat. Nickel	New York	14¼	13½	13⅝	Mar.' 19,	0.50
Internat. Nickel pfd.	New York	80	79¼	80	Oc.11, No.1 Q.	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	2⅛	2	2	.....	....
National Lead	New York	137¾	120	137⅜	De.14, De.31, Q	2.00
National Lead pfd.	New York	111	110½	111	Au. 24, Se.15 Q	1.75
St. Joseph Lead	New York	22¾	22	22⅛	Se.9, Se.20 Q, X	0.50
ZINC						
Am. Z. L. & S.	New York	7	6⅞	7	May '20,	1.00
Am. Z. L. & S. pfd.	New York	27	25½	25½	Nov. '20, Q	1.50
Butte C. & Z.	New York	5⅛	4⅞	5⅛	Mar '23,	0.50
Butte & Superior	New York	15⅞	14⅜	15	Je. 15, Je. 30, Q	0.50
Callahan Zn-Ld.	New York	4¼	4	4¼	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	147	145⅛	146½	Oc.31, No.10, Q	2.00
United Zinc	N. Y. Curb	...	...	*50	.....	....
Yellow Pine	Los Angeles	...	...	*70	June '23, Q	0.03
SILVER						
Alvarado	N. Y. Curb	1⅜	1	1	.....	....
Batopilas Mining	New York	⅛	⅛	⅛	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*21	*20	*21	May '20, K	0.03
Candelaria	N. Y. Curb	*3	*2	*3	.....	....
Castle-Trethewey	Toronto	*50½	*47	*50½	.....	....
Coniagas	Toronto	2.35	2.35	2.35	Oc.19, No.1, '23	0.02½
Crown Reserve	Toronto	*70	*67	*70	Jan. 17,	0.05
Kerr Lake	N. Y. Curb	2⅛	2	2⅛	Oc.1, Oc.15, Q	0 12½
La Rose	Toronto	*21	*20	*20	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	*14	*13	*14	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	3.00	2.92	3.00	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6⅜	6¼	6¼	Ja.1, Ja.21, QX	0.30
Ontario Silver	New York	9	7¼	7¼	Jan. '19, Q	0.50
Temiskaming	Toronto	*34½	*33	*33	Jan. '20, K	0.04

Stock	Exch.	High	Low	Last		Last Div.
GOLD						
Alaska Gold	New York	⅛	⅛	⅛	.....	....
Alaska Juneau	New York	1	½	½	.....	....
Boundary Red M.	N. Y. Curb	...	...	*12	.....	....
Carson Hill	Boston	2⅛	2⅛	2⅛	.....	....
Cresson Consol. G.	N. Y. Curb	3⅜	3⅜	3⅜	Se.30, Oc.10, Q	0.10
Dome Mines	New York	19⅝	19⅛	19½	De.31, Ja.2, Q	0.50
Golden Cycle	Colo. Springs	1.07	1.07	1.07	Dec. '22, Q	0 02
Hollinger Consol.	Toronto	11.48	11.40	11.45	De.13, Ja.3, M	0.05
Homestake Mining	New York	55½	54	55½	De.20, De.26 M	0.50
Kirkland Lake	Toronto	*20	*15	*15¾	.....	....
Lake Shore	Toronto	3.37	3.34	3.35	No.1, No.15'23	Q 0.02
McIntyre-Porcupine	New York	18⅛	17½	17⅝	De. 1, Ja. 2,	0.25
Portland	Colo. Springs	*56	*52	*52	Oct. '20, Q	0.01
Teck-Hughes	N. Y. Curb	1 3/16	1⅛	1 3/16	.....	....
Tom Reed	Los Angeles	...	...	*57½	Dec. '19,	0.02
United Eastern	N. Y. Curb	1	*85	*92	Oc.8, Oc.28, Q	0.15
Vipond Cons.	Toronto	*94½	*91	*91	.....	....
Wright-Hargreaves	Toronto	3.20	9.75	2.75	Se.15, Oc.1, Q	0.02½
Yukon Gold	N. Y. Curb	*80	*61	*62	June '18,	0.02½
GOLD AND SILVER						
Boston-Mont. Corp.	N. Y. Curb	*16	*12	*14	.....	....
Con. Cortez	N. Y. Curb	*58	*53	*58	.....	....
Con. Virginia	San Francisco	5½	4½	4½	.....	....
Continental Mines	N. Y. Curb	4	4	4	.....	....
Dolores Esperanza	N. Y. Curb	*75	*70	*70	Jy. 1, Jy.10 Q	0.05
Jib Consol	N. Y. Curb	...	...	*65	.....	....
Tonopah Belmont	N. Y. Curb	...	...	*36	Apr. '23, Q	0.05
Tonopah Divide	N. Y. Curb	*37	*37	*37	Se.22, Oc.10	0.10
Tonopah Extension	N. Y. Curb	1⅛	1 1/16	1⅛	De. 11, Ja. 1	0.05
Tonopah Mining	N. Y. Curb	1 1/16	1 1/16	1 1/16	Se. 30, Oc. 1	0.07½
Unity Gold	N. Y. Curb	1⅛	1	1	.....	....
West End Consol.	N. Y. Curb	*65	*55	*59	Mar. '23, Q	0.05
SILVER-LEAD						
Ahumada	Boston Curb	5⅛	4¾	5⅛	De.15, Ja.2, X	0.10
Bingham Mines	Boston	...	...	16	Sept. 19, Q	0.25
Cardiff M. & M.	Salt Lake	1.00	*97	*97	Dec. '20,	0.15
Chief Consol.	Boston Curb	3¾	3½	3¾	Oc.10, No.1, Q	0.10
Columbus Rexall	Salt Lake	*31½	*27	*31	Aug. '22,	0.03
Consol. M. & S.	Montreal	29	27	28½	Oct. '20, Q	0.62½
Erupcion	Boston Curb	...	...	1⅞	De.15, Ja.2, X	0.125
Federal M. & S.	New York	...	...	9¼	Jan., '09,	1.50
Federal M. & S. pfd.	New York	43	41½	43	No.26, De.15,	1.75
Florence Silver	Spokane	*13½	*13	*13½	Apr. '19, Q, X	0.01
Hecla Mining	N. Y. Curb	8⅝	8⅜	8⅜	Au.15, Se.15	0.15½
Iron Blossom Con.	N. Y. Curb	....	....	*31	Oct.25, '23,	0.02
Marsh Mines	N. Y. Curb	*10	*10	*10	June '21, I	0.02½
Park City	Salt Lake	3.87½	3.80	3.87½	Se.15, Oc.1 Q	0.12
Park Utah	N. Y. Curb	4	4	4	Ja. 1, Q	0.15
Prince Consol.	Salt Lake	...	...	*75	Nov. '17,	0.02
Silversmith	Spokane	*32	*31	*32	Oc. 1, Oc. 10	0.01
Simon Silver-Lead	N. Y. Curb	....	....	*1	.....	....
Snowstorm Silver-L.	N. Y. Curb	...	...	*46	.....	....
Tamarack-Custer	Spokane	1.35	1.30	1.35	Se.30, Oc.1, K	0.02
Tintic Standard	Salt Lake	3.70	3.57½	3.57½	Se. 24, Se. 29	0.15
Utah-Apex	Boston	2⅞	2⅝	2⅞	June '23, Q, X	0.50
IRON						
Bethlehem Steel	New York	53½	51	51½	De.1, Ja.2, Q	1.25
Char. Iron	Detroit	⅜	5/16	5/16	.....	....
Char. Iron pfd	Detroit	1⅝	1⅝	1⅝	.....	....
Colorado Fuel & Iron	New York	23⅛	22½	23	No.10, No.26	Q 2.00
Col. Fuel & Iron pfd.	New York	...	...	102	Feb.'23, Q	2.00
Gt. North'n Iron Ore	New York	29	27¼	27⅜	Apr. '23	1.00
Inland Steel	N. Y. Curb	...	...	46	No.15, De.1	Q 0.62½
Mesabi Iron	N. Y. Curb	...	...	5	.....	....
Replogle Steel	New York	13½	10½	11	.....	....
Republic I. & S.	New York	50	46½	48½	May '21	1.50
Republic I. S. pfd.	New York	89⅞	89	89½	De.15, Ja.2	Q 1.75
Sloss-Sheffield S. & I.	New York	60¼	55¼	56½	Feb.'21,	1.50
Sloss-Shef. S. & I. pfd.	New York	84	84	84	De.20, Ja.2,	Q 1.75
U. S. Steel	New York	96	93⅝	94⅜	No.29, De.29,	Q 1.50
U. S. Steel pfd.	New York	119⅛	119⅛	119⅛	No.4, No.28,	Q 1.75
Virginia I. C. & C.	New York	...	...	53	De.15, Ja. 2	1.50
Virginia I.C.&C.pfd.	New York	...	...	80	De.15, Ja.22	2.50
VANADIUM						
Vanadium Corp.	New York	32⅜	29	29⅞	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	33½	29	29	Se.29, Oc.15	Q 1.00
Asbestos Corp. pfd.	Montreal	60	59½	59½	Se.29, Oc.15	Q 1.50
SULPHUR						
Freeport Texas	New York	13½	12½	12⅝	Nov. '19, Q	1.00
Texas Gulf	New York	62	58⅝	60½	De.1, De.15	QX 2.00
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	3¼	2⅛	2⅛	.....	....
MINING, SMELTING AND REFINING						
Amer. Metal	New York	42½	41	41½	No. 17, De. 1,	Q 0.75
Amer. Metal pfd.	New York	109	106½	106½	No.19, De 1,	Q 1.75
Amer. Sm. & Ref.	New York	58½	56½	57⅝	Oc.11, No.1,	Q 1.25
Amer. Sm.& Ref. pfd	New York	96⅜	95⅜	95⅜	No.9, De.1,	1.75
U. S. Sm. R. & M.	New York	21½	18⅞	19⅝	Jan. '21, Q	0.50
U.S. Sm.R.& M. pfd.	New York	39½	39	39½	Oc.8, Oc.15, Q	0.87½

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Arthur E. Moysey; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Mines and Oil; Colorado Springs, Colorado Springs Stock Exchange.

Volume 116 December 29, 1923 *Number* 26

ENGINEERING & MINING JOURNAL-PRESS

J. E. SPURR, Editor.

GEORGE J. YOUNG, Associate Editor
San Francisco, Calif.
A. W. ALLEN, San Francisco, Calif.

T. A. RICKARD, Contributing Editor.
San Francisco, Calif.
A. H. HUBBELL, Managing Editor

Assistant Editors

E. H. ROBIE
F. E. WORMSER

A. B. PARSONS
W. N. P. REED

Tenth Ave. at 36th St., New York City
883 Mission St., San Francisco, Calif.
Colorado Building, Washington, D. C.

Contents

*Illustrated Article

Editorial 1101

The Prospector and the Land Office.
Mining Under the Sea.
Visual Examination of Crushing Action.
Local Doings in Goldfield.
"My Lady Nicotine" and the Bureau of Mines.
King Oil.
Gold or Iridium in Mono Lake.
Leonia's Clean-Up Delayed.
Royal School of Mines Alumni.

Professional Status of Mining Engineers 1104

As viewed by Frank L. Sizer.

***Selective Flotation a Feature at the Magistral-Ameca Plant** 1105

By Henry Mace Payne.

Trade Statistics and the Non-Ferrous Metals 1109

By Felix Edgar Wormser and Edward H. Robie.

A Comparative Test of Cyanide of Different Grades 1112

By Fred C. Bond.

The Chino Enterprise—IV. 1113

By T. A. Rickard.

Measuring Depth Accurately in Rotary Well Drilling 1122

By Albert G. Wolf.

Discussion 1124

What Has Become of the Prospector?
The Society of Doodle-bug Operators.
Comment on Ball Milling.
Welcome the Coming, Speed the Parting.
Concerning Prospect Prices.
Who Can Answer This?

Consultation 1127

Combining Prospecting and a Mining Education.
No American Market for Antimony Ores.

Societies, Addresses and Reports 1128

Recent Technical Publications 1129

Men You Should Know About. Obituary 1130

The Mining News 1131

Ohio Copper Increases Output.
Larder Lake, Ont., Is to Have 600-Ton Mill.
Thompson Smelter in Nevada May Be Restarted.
Good Outlook for Park City, Utah.
Calumet & Hecla Expands Development Program.
Real del Monte Mills 3,500 Tons per Day at Pachuca, Mexico.
New Surface Plant at Eureka Mine on Gogebic Range.
Senator Pittman Wants Investigation of War Minerals Administration.
Rich Ore in Esperanza Mine in British Columbia.
Mill Planned for Pioche, Nev., Ores.
Optimistic Views on Government Areas in South Africa.

New Machinery and Inventions 1139

Markets 1140

Company Reports 1142

Facts for the Stockholder 1143

Mother Lode Coalition Mines Co.

Stocks 1144

Searchlight Section 24-25

Professional Directory 42

What and Where To Buy 48

Advertising Index 54

McGRAW-HILL COMPANY INC., Tenth Ave. at 36th St., NEW YORK

JAMES H. McGRAW, President
ARTHUR J. BALDWIN, Vice-President
MALCOLM MUIR, Vice-President
E. J. MEHREN, Vice-President
MASON BRITTON, Vice-President
JAMES H. McGRAW, JR., Secy. and Treas.

WASHINGTON, Colorado Building
CHICAGO, Old Colony Building
PHILADELPHIA, Real Estate Trust Building
CLEVELAND, Leader-News Building
ST. LOUIS, Star Building
SAN FRANCISCO, 883 Mission Street
LONDON, 6 Bouverie St., London, E. C. 4

Cable Address: "Machinist, N. Y."
Copyright 1923, by McGraw-Hill Company, Inc.
Publishers of
Engineering News-Record American Machinist
Power Chemical and Metallurgical Engineering
Coal Age Engineering and Mining Journal-Press
Ingeniería Internacional
Electrical World Electrical Merchandising
Bus Transportation Electric Railway Journal
Journal of Electricity and Western Industry
(Published in San Francisco)
Industrial Engineer
(Published in Chicago)
Electrical Retailing
(Published in Chicago)
American Machinist—European Edition
(Published in London

The annual subscription rate in the United States, Canada, Mexico, Alaska, Hawaii, Philippines, Porto Rico, Canal Zone, Honduras, Cuba, Nicaragua, Peru, Colombia, Bolivia, Dominican Republic, Panama, El Salvador, Argentina, Brazil, Spain, Uruguay, Costa Rica, Ecuador, Guatemala, and Paraguay, $5 per year; elsewhere, $8. Single copy, 25c.
Change of Address—When change of address is ordered the new and the old address must be given. Notice must be received at New York at least ten days before the change takes place.
Published weekly. Entered as second-class matter June 20, 1879, at the Post Office at New York under the Act of March 3, 1879.
Printed in U. S. A.
Member Audit Bureau of Circulations.
Member Associated Business Papers, Inc.

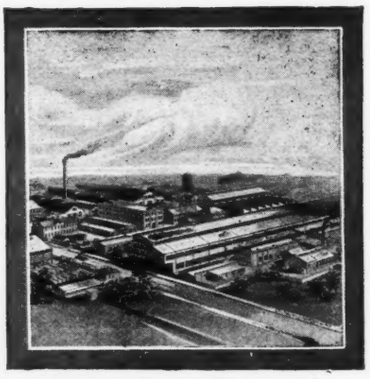
11,875 COPIES PRINTED THIS ISSUE

Jeffrey Material-Handling Equipment

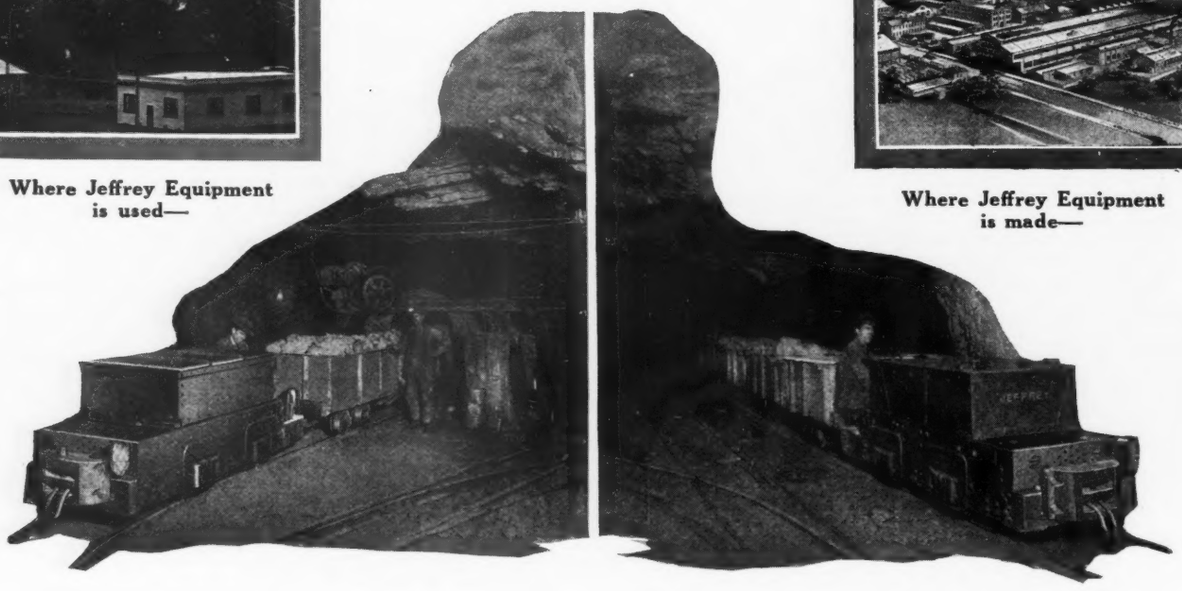
as used by the American Zinc, Lead & Smelting Co.

Where Jeffrey Equipment is used—

STORAGE BATTERY LOCOMOTIVE



Where Jeffrey Equipment is made—



ZINC ore is hauled from the mines of the American Zinc, Lead and Smelting Company, at Mascot, Tennessee, by Jeffrey 4-ton Storage Battery Locomotives.

At the time of original installation, one locomotive was handling the entire ore output of 15 round trips daily, each trip consisting of 8 cars; the hauling distance being 1000 feet. And this was done on a single charge of battery.

Jeffrey Storage Battery Locomotives for metal mines are furnished for gauges from 18 in. and up. Those built for narrow gauges are equipped with a motor known as M H 108 mounted with the armature shaft lengthwise of the Locomotive and drives the axle directly through single reduction worm and worm wheel gearing.

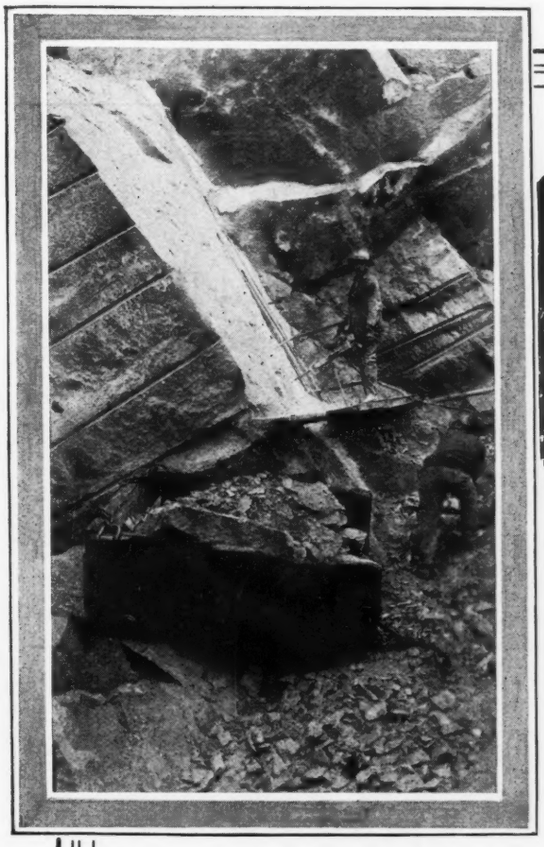
This arrangement permits of a larger and more efficient motor equipment on narrow gauges than would be possible with a motor mounted between the wheels with the armature shaft cross-wise of the locomotive. The worm wheel has a high mechanical efficiency, is noiseless and permits the locomotive to coast with perfect ease.

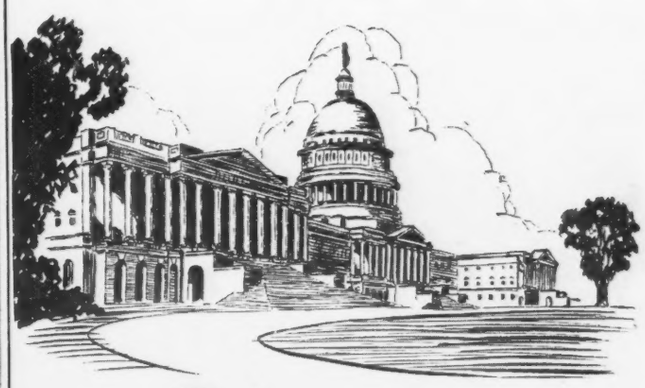
The Jeffrey Manufacturing Company, Columbus, Ohio

NEW YORK, 30 Church Street — CHICAGO, 858 McCormick Bldg. — PHILADELPHIA, 515 Real Estate Tr. Bldg.
PITTSBURGH, Rea Bldg., 620 Second Ave. — MONTREAL, Canada, Power Bldg.

SCRANTON, PA., 518 Union Nat'l Bank Bldg. — ST. LOUIS, MO., 606 Pontiac Bldg. — BOSTON, MASS., 141 Milk Street
CLEVELAND, OHIO, 1519 Guardian Bldg. — DETROIT, MICH., 455 Book Bldg. — LOS ANGELES, CAL., H. W. Hellman Bldg.
DENVER, COLO., 1751 Wazee Street — MILWAUKEE, WIS., M. & M. Bldg. — CHARLESTON, W. VA., 914 Kanawha Street

JEFFREY
MINE EQUIPMENT





Stone *for the* State

MAJESTIC in its dignity, sublime in its effect, the new State Capitol at Olympia, Washington, rises from its foundations to inspire in us respect for the great Government it represents.

BUT before this beautiful building could be erected, many hard and tedious tasks had to be performed, not least of which was the quarrying of the building stone by careful, capable men, working with fast, efficient machines.

AND here Waugh rock drills played their usual unobtrusive but effective part, performing their work at minimum cost with maximum speed and efficiency.

WHETHER it be for a beautiful building, like the Washington State Capitol, or for a mere highway foundation job, wherever stone is to be quarried, a Waugh drill can do the work to best advantage.

TELL us about your conditions and rock formation and we'll provide a Waugh drill that will solve your problem speedily and to your complete satisfaction.

"The Waugh Way Wins"

THE DENVER ROCK DRILL MANUFACTURING COMPANY

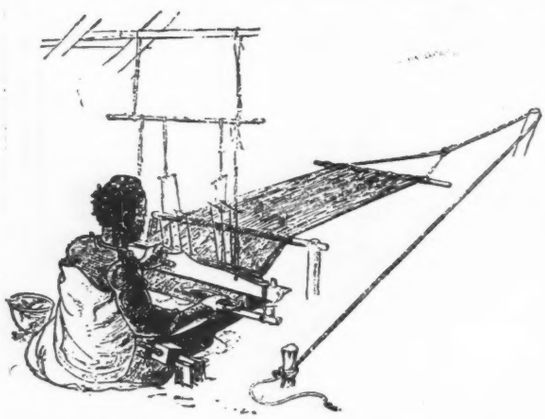
DENVER COLORADO

Rock Drills, Drill Steel Sharpeners and Hole Punchers, Portable Hoists

San Francisco	Duluth	Lima	Birmingham
Scranton	Joplin	Santiago	Melbourne
El Paso	Wallace	Butte	Mexico City
St Louis	Salt Lake City	New York	Pottsville
Seattle	Pittsburgh	Houghton	

ROCK WAUGH DRILLS

Canadian Rock Drill Company, Limited, Sole Agents in Canada
Montreal, Quebec Cobalt, Ont Nelson, B C. Vancouver, B C
The Denver Rock Drill & Machinery Company, Limited
Sole Agents in South Africa and Rhodesia
Southern Life Building, Johannesburgh, Transvaal, S. Africa
Andrews & George Company, Sole Agents in Japan, Tokio, Japan



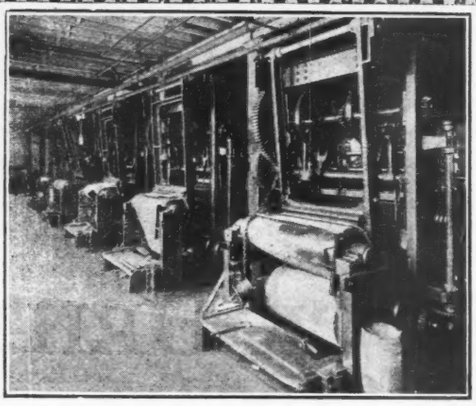
Indian Hill Tribesman's Loom

Reproduced by permission of the publishers of the Encyclopaedia Britannica

Weaving Throughout the Ages—No. 2

Cleopatra's Royal Robes
were woven on a loom like this

This step forward in the construction of the first crude grass-weaving loom is virtually of undateable age. The Ancient Egyptians and Greeks used such Looms for their linen textiles—a far cry from the wonderful wire-weaving looms of modern industry. The agonizing care that made the royal Cleopatra's robes is duplicated by machine in weaving "Perfect" products.



These giant Double-Crimping Looms are weaving truly "Perfect" Screens. Their heavy beaters space each mesh with absolute precision; and by their "Perfect" Double Crimp the wires retain their fullest strength—no strains nor broken surfaces. Each wire is fixed immovable—and yet undamaged in the weaving. A scientific tempering attends the weaving of all "Perfect" screens; the woven wires are hard and tough, for long and rugged service.

"Perfect"

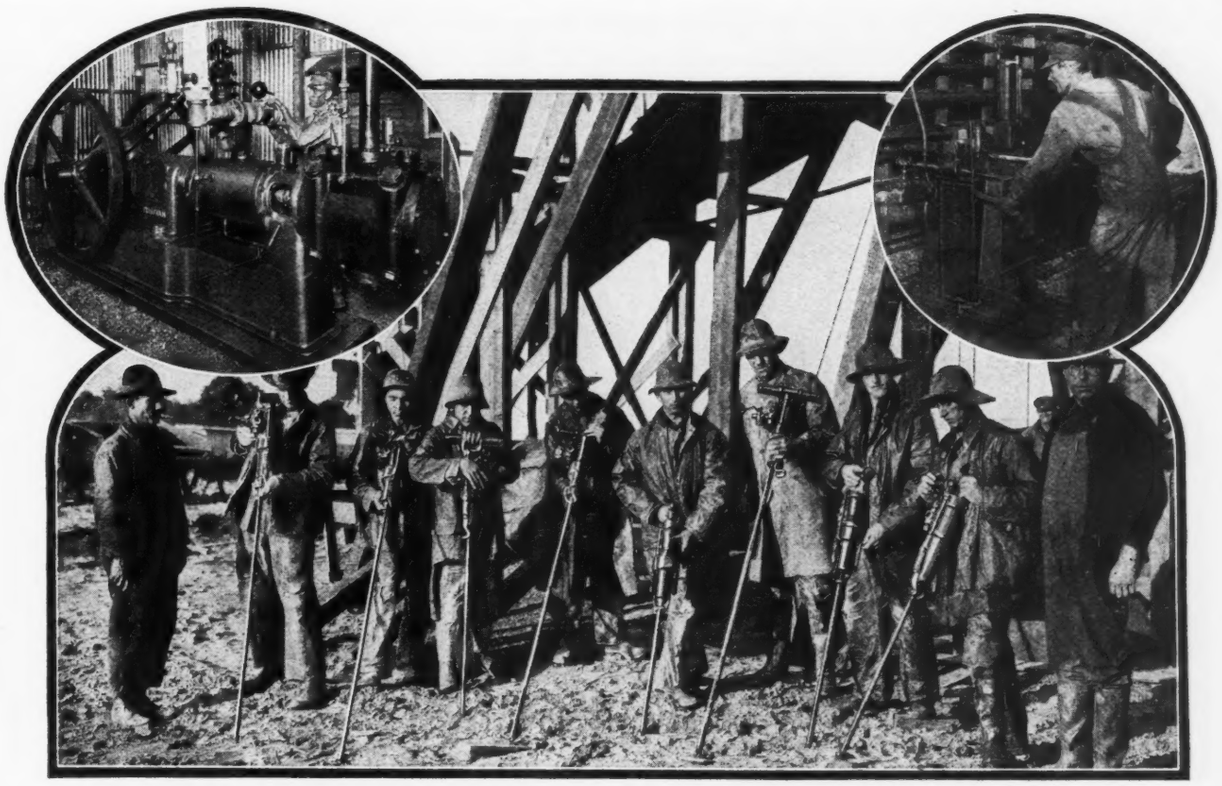
Double Crimped Wire Screens

would have satisfied the Egyptian taskmasters in their merciless insistence on durability and accomplishment—and the Greeks in their passion for simplicity, strength and perfection.

Over 1,000 grades of "Perfect" Screens are listed in our Catalog. A given Opening may be supplied in any one of several weights of screen, so that maximum speed of output, or maximum resistance to wear, flexibility or rigidity, or any other screen requirement can be supplied from standard grades of screen.

If you do not have our Catalog, send for your free copy. Digests of the data shown therein may also be found in the Keystone Mining Catalog for 1923.

The Ludlow-Saylor Wire Co.
St. Louis, Mo.



Starting The Largest Illinois Mine

At Nason, Jefferson County, Illinois, the Illinois Coal Corporation is opening what will be the largest mine in the state, with a contemplated output of 10,000 to 12,000 tons per 8 hours.

Sullivan Diamond Drilling

The first step was to drill the property thoroughly, to prove the seam, and place the shafts. Sullivan Contract Core Drilling service bored 24 holes with the diamond drill.

Illinois Shaft Records Made

Two shafts have been sunk to the No. 6 vein, 720 ft. deep. "A" shaft is 21x12 ft. 5 in., while "B" shaft is 31x12 ft. 5 in. Both shafts broke ground April 23, 1923, and "A" reached the coal Nov. 13, setting a record for Illinois, measured by the advance and the material removed. "A" shaft averaged 8 ft. per 24 hrs. "B" shaft 5 ft. per 24 hrs. Six weeks were lost in passing through a bed of quicksand 70 ft. below surface.

Sinking With Sullivan Rotators

Sullivan Rotators were used in both shafts throughout, 55-58 holes, 6 to 8 ft. deep were drilled per round in "B" and 37-42 holes in "A" shaft.

Sullivan Air Compressor

Air power for the drills and sharpener was supplied by a Sullivan straight line, single stage compressor, steam driven, Class "WA-6" of 513 cu.ft. displacement.

Sullivan Drill Sharpener

The ⅞-in. hollow hexagonal drill steel was sharpened (4-point cross bits) by a Sullivan Compressed Air Sharpener of the all-hammer 1500-lb. "B" type.

Water Supply

Test wells are being sunk in the endeavor to establish a water supply for the mine and the new town of Nason. These are pumped by the Sullivan "Air Lift."

The story is in Mine and Quarry, for November. Send for your copy.

DOMESTIC SALES OFFICES

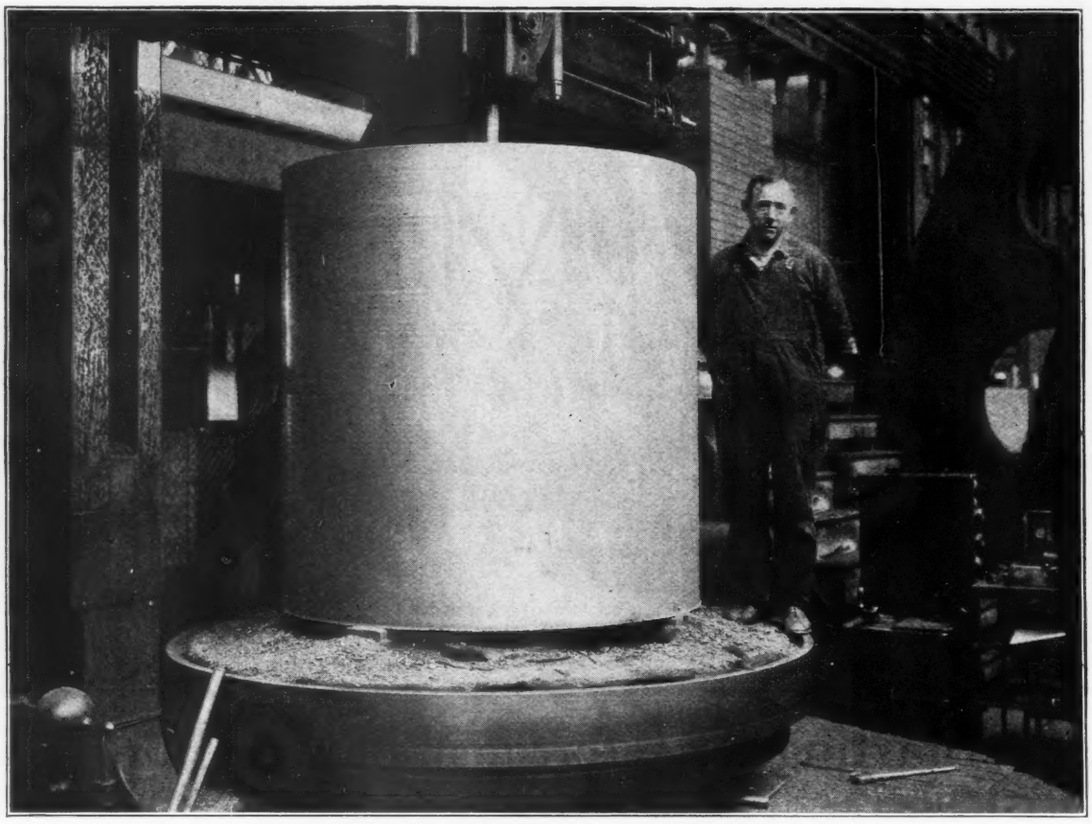
Birmingham, Boston, Butte, Claremont, N. H., Cleveland, Dallas, Denver, Duluth, El Paso, Huntington, W. Va., Joplin, Juneau, Knoxville, New York, Pittsburgh, St. Louis, Salt Lake, San Francisco Spokane.

COMPRESSORS AIR LIFT DIAMOND DRILLS SHARPENERS FORGES
FORGE HAMMERS COAL CUTTERS ROCK DRILLS DRILLING CONTRACTORS

SULLIVAN MACHINERY COMPANY
126 So. Michigan Ave. Chicago.

FOREIGN SALES OFFICES

Algiers, Brussels, Calcutta, Christiania, Durban, Natal, Havana, Lima, London, Madrid, Mexico City, Paris, San Juan, Santiago, Shanghai, Sydney, N. S. W., Tokyo, Toronto, Tunis, Turin, Vancouver.



An ALLIS-CHALMERS 60 in.x 60 in. One-Piece Pulley

Do you know ALLIS-CHALMERS Transmission Machinery?

Do you know that there isn't a shop in the country surpassing us in the equipment for this class of work?

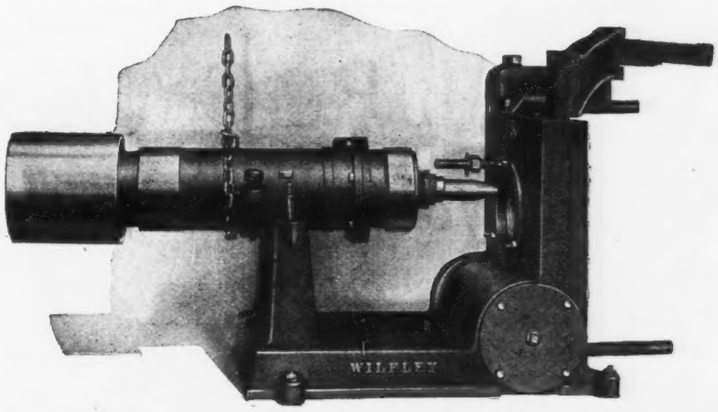
Do you know that we MAKE turned shafting while most Transmission manufacturers buy it?

Write us about anything in turned or forged shafting, bearings, cast iron pulleys, cut gearing the bigger the better.

ALLIS-CHALMERS PRODUCTS
Electrical Machinery
Steam Turbines
Steam Engines
Gas and Oil Engines
Hydraulic Turbines
Crushing and Cement Machinery
Mining Machinery

ALLIS-CHALMERS MANUFACTURING COMPANY
MILWAUKEE, WISCONSIN. U.S.A.
District Offices in All Leading Cities.

ALLIS-CHALMERS PRODUCTS
Flour and Saw Mill Machinery
Power Transmission Machinery
Pumping Engines-Centrifugal Pumps
Steam and Electric Hoists
Air Compressors - Air Brakes
Agricultural Machinery
Condensers



"UNIT CONSTRUCTION"

The bearing assembly of the Wilfley Pump is of unit construction and consists of large ball bearings mounted on a heavy shaft and enclosed in a cylindrical housing that assures perfect bearing alignment and protection at all times.

This is made possible through the use of our patented centrifugal seal which eliminates wear on the shaft.

Let us show you how Wilfley Pumps will reduce your cost of elevating gritty material and hot or muddy solutions.

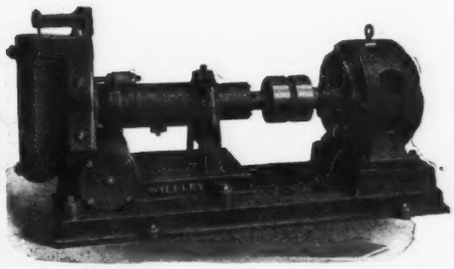
Your Inquiry

Will have the personal attention of Mr. Wilfley

A. R. Wilfley & Sons

2763 Blake St., Denver, Colo., U. S. A.

Merry Christmas



Happy New Year

WILFLEY CENTRIFUGAL SAND PUMP

PATENTED

CENTRIFUGAL WILFLEY PUMPS

Telsmith Re-Crusher

Built Specially for Secondary Reduction

When you want a mine foreman you hire a man specially trained for the job — not a book-keeper or a cook. On the same principle, we recommend the Telsmith Re-Crusher for follow-up crushing. It will not take mine-run ore; nor can it do the work of a ball-mill. It's designed and built to follow a coarse crusher, reducing the ore to ball-mill size. This class of work it does remarkably well. It's large open feed hopper permits an unregulated gravity flow of ore into the machine. The enormous discharge diameter clears freely with a heavy choke feed. The short massive frame castings are both STEEL, guaranteed against breakage even by tramp iron. The bolt-shaft carries the same guarantee. Discharge is by gravity without centrifugal action and with very little wear of the crusher structure.

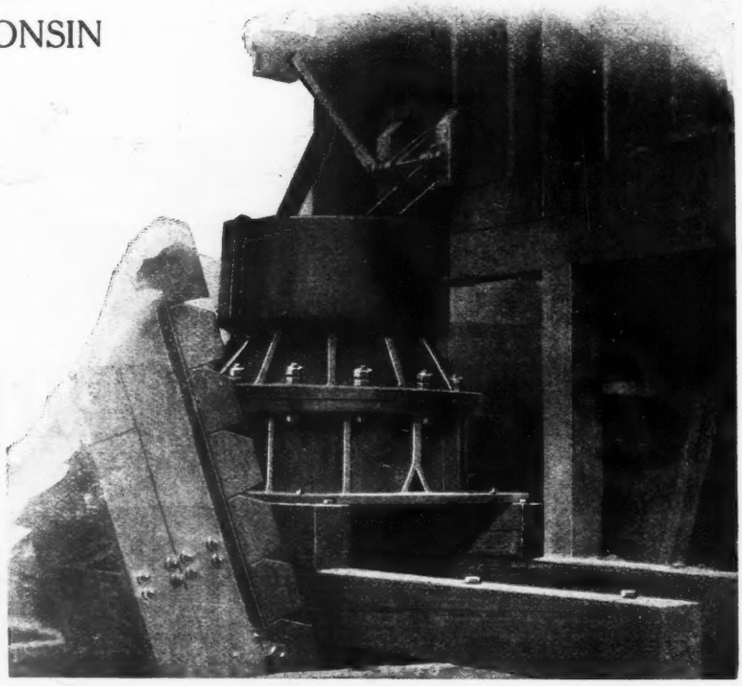
There is a new book containing full data about Telsmith Crushers. Glad to send you Catalog No. 168 (Telsmith Primary Breaker) and Bulletin No. 2-F-I (Telsmith Reduction Crusher). If yo u want them, just say so. No obligation.

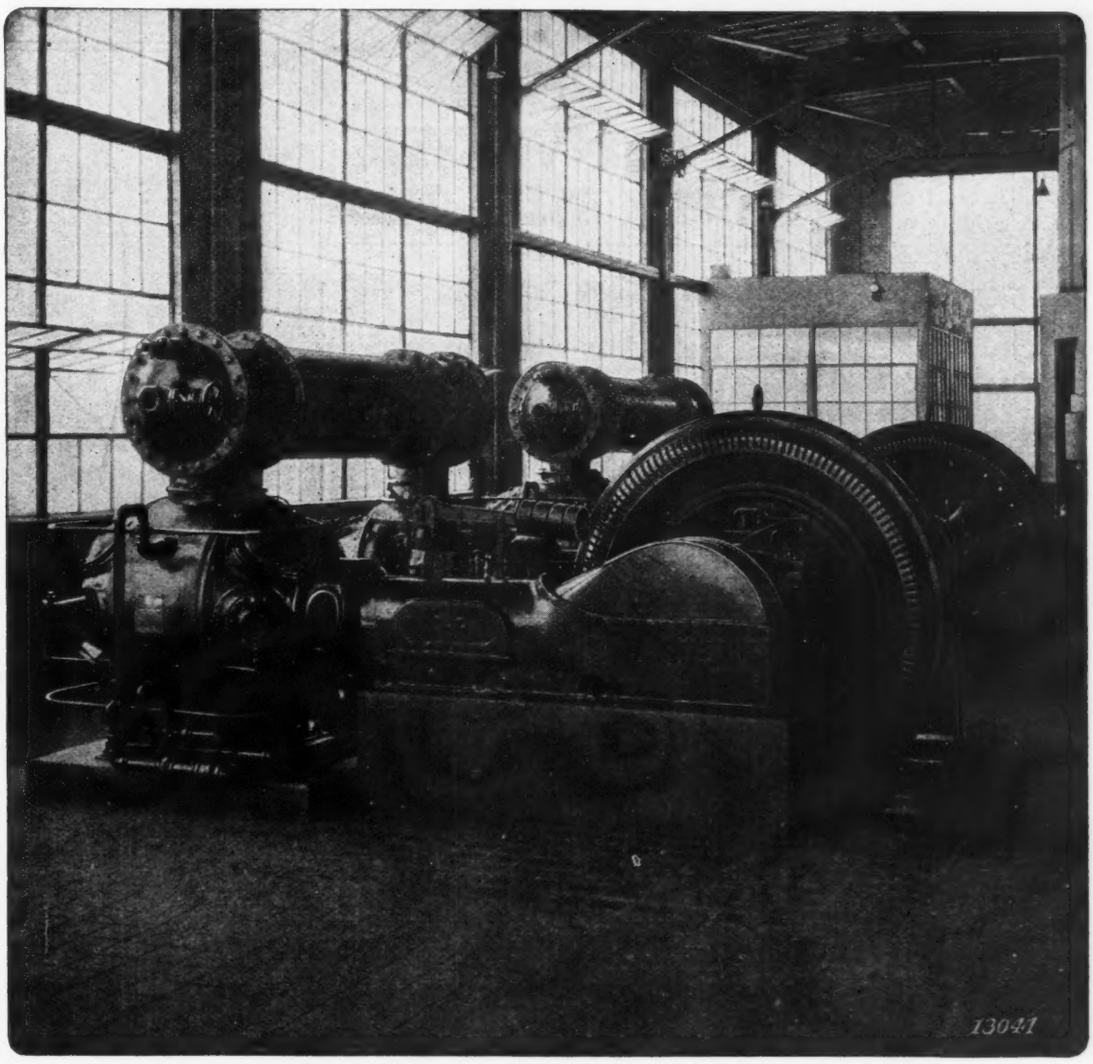
SMITH ENGINEERING WORKS

3195 LOCUST STREET
MILWAUKEE, WISCONSIN

Canadian Representatives:
Canadian Ingersoll-Rand Co., Montreal, P.Q.

Old Colony Bldg., Chicago, Ill.
50 Church St., New York City
806 Otis Bldg., Philadelphia, Pa.
261 Franklin St., Boston, Mass.
110 W. Park Way, Pittsburgh, Pa.
325 W. Main St., Louisville, Ky.
Franklin and Channing Aves., St. Louis, Mo.
2540 University Ave., St. Paul, Minn.
General Agents for Western States: Mine & Smelter Supply Co., Denver, Salt Lake, San Francisco, El Paso.





INGERSOLL-RAND Compressors are built to operate with maximum economy; *to actually deliver the greatest number of cubic feet of air per dollar spent for power repairs, and attendance.*

This has been the creed of the manufacturers for over 50 years, each one of which has witnessed better air compressors and greater production. The purchaser of an air compressor should appreciate this aim of the company—an aim which guarantees correct design, good service, high quality, right prices and intelligent engineering-salesmanship. *Let us send you complete information.*

INGERSOLL-RAND COMPANY, 11 Broadway, New York City

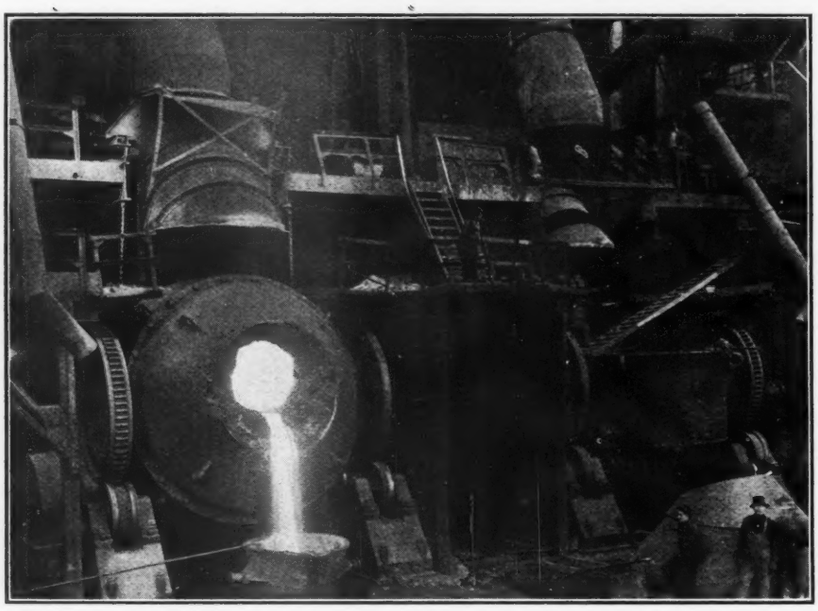
Branch offices in all Principal Domestic and Foreign Cities

For Canada, refer Canadian Ingersoll-Rand Co., Limited, 260 St. James Street, Montreal

735-C

Ingersoll-Rand

Traylor COPPER CONVERTERS GREAT FALLS TYPE



Traylor 12'-0" Great Falls Type Converters, Consolidated Mining and Smelting Co. of Canada, Trail, B. C.

Improved Tuyere Equipment— keeps operating costs at rockbottom

Characteristic of Traylor aims and policies, Traylor Copper Converters embody many unique features which have proved their ability to further efficiency and cut costs in practical everyday service.

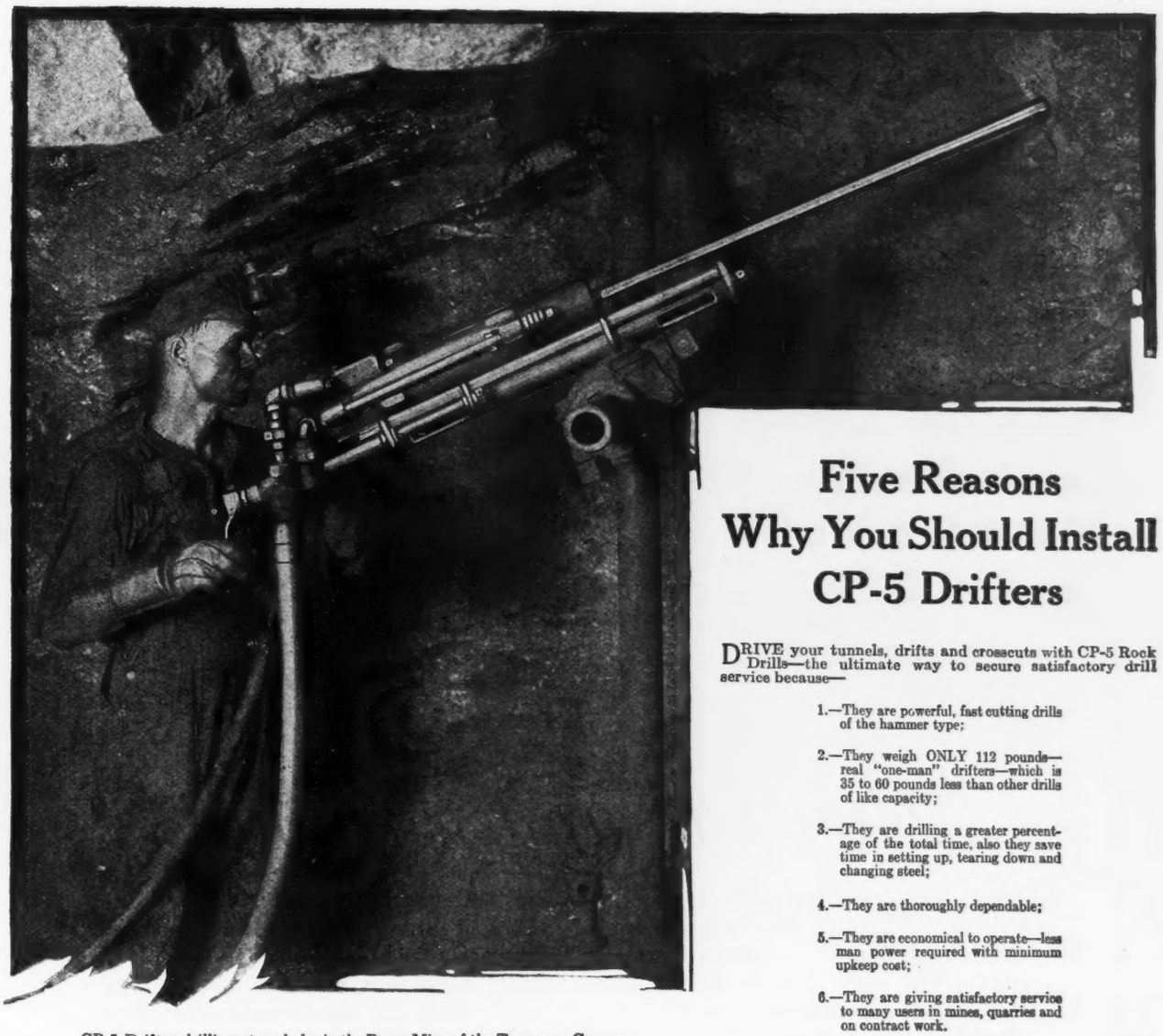
For instance, both the Great Falls and Horizontal Types are fitted with Williams Connections on the tuyere boxes and with improved type Shelby Tuyere Valves. Thus the tuyere boxes can be removed without disturbing the tuyere pipes, and the universal air connection permits a complete revolution of the converter.

Tried and proven improvements which mean worth-while savings on lining costs, and in non-production time.

Outline your requirements. We'll gladly send details.

TRAYLOR
ENGINEERING AND MFG. CO.
ALLENTOWN, PA.

New York 30 Church St | Pittsburgh 1306 Fulton Bldg. | Chicago 1414 Fisher Bldg | Los Angeles I. W. Hellman Bldg. | Seattle 815 Alaska Bldg.
Salt Lake City 101 W. 2nd South St. | Laredo, Texas 1806 Farragut Ave. | Timmins, Ontario, Canada Moore Block
Export Department, 104 Pearl Street, New York City — Cable Address "Forsaltra"
International Machy. Co., Santiago, Chile — W. R. Grace & Co., Lima, Peru
International Machy. Co. Rio de Janeiro, Brazil



CP-5 Drifter drilling stope holes in the Burra Mine of the Tennessee Copper Company at Copper Hill, Tenn.

Five Reasons Why You Should Install CP-5 Drifters

DRIVE your tunnels, drifts and crosscuts with CP-5 Rock Drills—the ultimate way to secure satisfactory drill service because—

1.—They are powerful, fast cutting drills of the hammer type;

2.—They weigh ONLY 112 pounds—real "one-man" drifters—which is 35 to 60 pounds less than other drills of like capacity;

3.—They are drilling a greater percentage of the total time, also they save time in setting up, tearing down and changing steel;

4.—They are thoroughly dependable;

5.—They are economical to operate—less man power required with minimum upkeep cost;

6.—They are giving satisfactory service to many users in mines, quarries and on contract work.

You are invited to make a thorough test of CP-5 Drifters under your conditions—in your own way. Write for Special Publication 697. It gives the details of the CP-5 and other types of CP Rock Drills.

Chicago Pneumatic Tool Company

6 East 44th Street, NEW YORK, N. Y.

*Sales and *Service Branches all over the World*

*Birmingham	*Cleveland	Houston	*New York	Salt Lake City	Tulsa	Brussels	Havana	London	Montreal	Rotterdam	Shanghai	*Vancouver
*Boston	Denver	*Los Angeles	*Philadelphia	*San Francisco	Basle	*Buenos Aires	Helsingfors	Manila	Osaka	Santiago	Tampico	*Winnipeg
*Chicago	*Detroit	*Minneapolis	*Pittsburgh	Seattle	Berlin	Christiania	Honolulu	Milan	Paris	*Sao Paulo	Tokyo	
*Cincinnati	El Paso	*New Orleans	Richmond	*St. Louis	Bombay	Dairen	Johannesburg	*Montevideo	*Rio de Janeiro	Seoul	*Toronto	

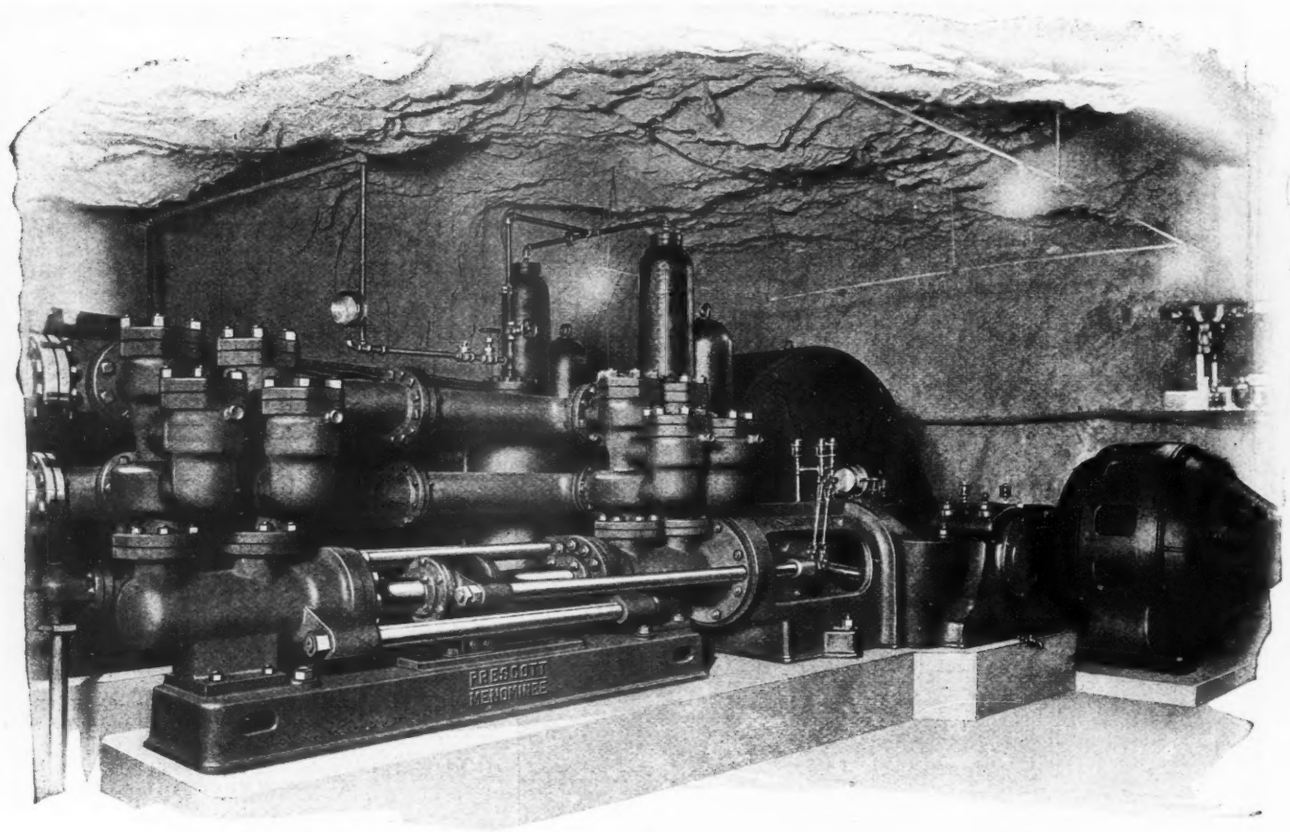
Canadian Pneumatic Tool Company, Ltd., Montreal, manufacturers of Chicago Pneumatic products in Canada.

R-55

BOYER PNEUMATIC HAMMERS · · LITTLE GIANT PNEUMATIC AND ELECTRIC TOOLS
CHICAGO PNEUMATIC AIR COMPRESSORS · · VACUUM PUMPS · · PNEUMATIC HOISTS
GIANT OIL AND GAS ENGINES · · ROCK DRILLS · · COAL DRILLS

CHICAGO PNEUMATIC

Rock Drills



2400 feet underground!

Here is another installation of Prescott-Menominee Pumps which demonstrates that single-lift pumping is not only practical but also the most economical method for draining deep mines. Operating against a 2400 foot head this pump is lifting water clear to the surface, without relaying or shambling. The pumping equipment is concentrated on one level, thus insuring simplicity, economy and efficiency.

The best tribute to the efficiency of Prescott-Menominee Pumps is in the good work they are doing at so many mines. Many of these pumps are being operated week in and week out without a stop, and with no lowering of their efficiency. Their service has given a true meaning to the word "dependability."

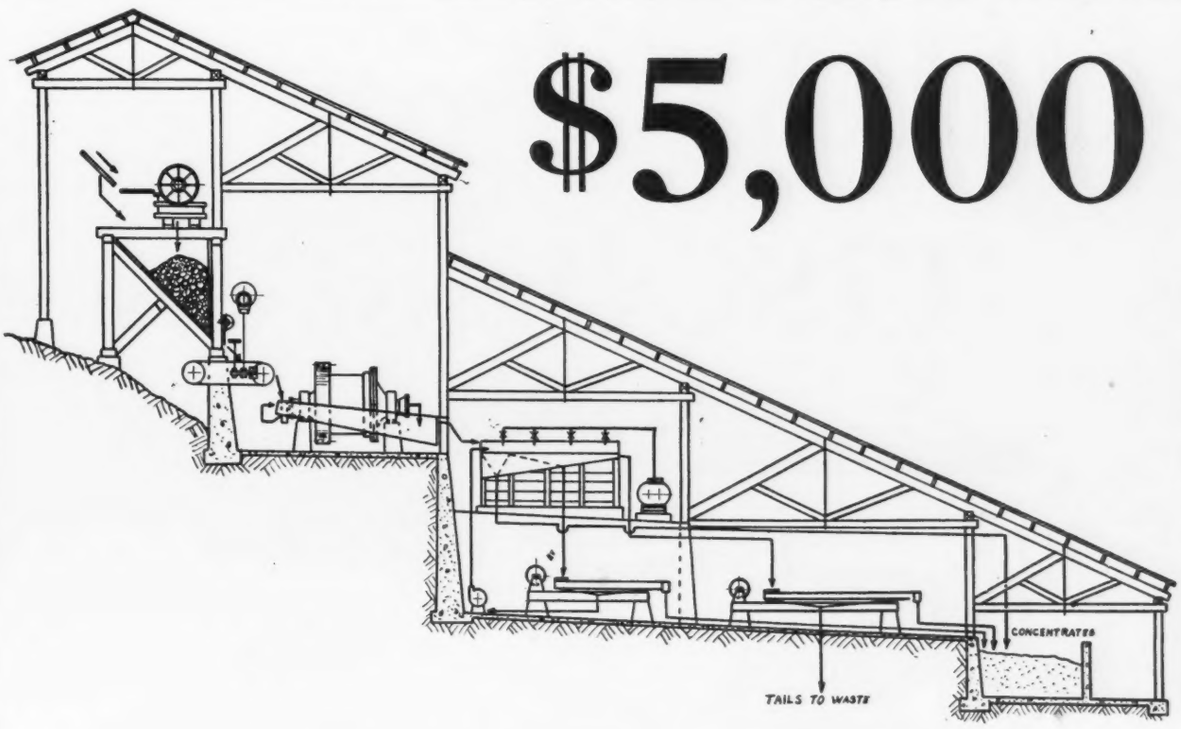
Prescott Company engineers will advise with you regarding the best method for keeping your mine drained, without pressing the purchase of Prescott-Menominee Pumps. Write for booklet.

The Prescott Company

Fred. M. Prescott, President

Menominee, Mich.

PRESCOTT
MENOMINEE



$5,000

The Devil of Development

THE devil of development work is that it usually means deferred profits.

HOWEVER, with an efficient $5,000 Stearns-Roger mill on the job while your ore is being blocked out, you ought to easily make your development work show a profit and at the same time satisfactorily work out your milling problem.

THIS $5,000 Stearns-Roger mill has a capacity of from 15 to 20 tons and contains the following standard equipment:

- 1—3x3 Grizzly
- 1—Primary Jaw Crusher
- 1—Ore bin gate (rack and pinion type)
- 1—Ore feeder
- 1—SR Feeder Speed control
- 1—3x3 Dewco Ball Mill
- 1—2 in. Centrifugal Pump
- 1—Dorr Classifier
- 1—4 cell 4-foot Brown Flotation machine
- 1—Flotation type blower
- 1—Deister Overstrom Pilot table
- 1—Deister Overstrom Concentrate Table
- 1—Oil feeder

Submit your milling problem to our engineers and let them solve it for you. Either a small sample test at the cost of assays only or a large tonnage test (preferably a carload) at nominal expense can be made under your supervision, using the above equipment. Our engineers will then be glad to furnish you with complete foundation plans and general arrangement mill drawings.

THE STEARNS-ROGER MFG. CO.
ENGINEERS MANUFACTURERS CONTRACTORS
DENVER, COLO.
MINING AND MILLING MACHINERY AND PLANTS

TAYLOR-WHARTON IRON & STEEL CO.

TIOGA STEEL & IRON CO. | WM WHARTON Jr. & CO. INC. | PHILADELPHIA ROLL & MACH

TISCO MANGANESE STEEL

Tisco Manganese Steel Van-Port Reversible Dipper Tooth (Patented)

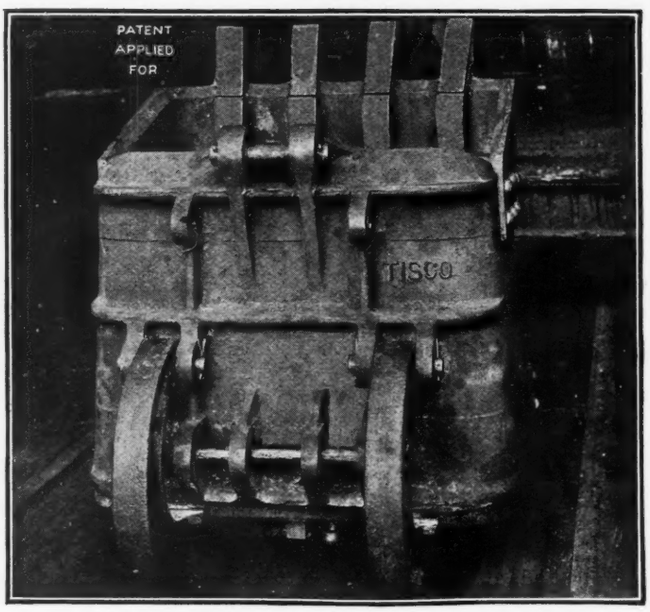
The Harder the Digging the Tighter the Point

The only tooth that does not depend upon a bolt for strength and tightness.

No loose or broken points with this design tooth.

Get our exchange proposition on this tooth.

ONE-PIECE Manganese Steel Dipper with a **RENEWABLE** Manganese Steel **LIP** carrying Reversible Van-Port points, eliminating weight of bases. No riveted joints to get loose; a one-piece dipper for the most severe digging conditions at practically the same cost as the long used, built-up type. Made in sizes ⅝-yd. to 2½-yd. capacity for all makes of shovels. This dipper delivers maximum service. May we quote you? Advise yardage, make and shop number of shovel.



Tisco One-Piece Dipper

Taylor-Wharton Iron & Steel Co.

High Bridge, New Jersey

Tisco Manganese Steel is manufactured under the Taylor-Hadfield and Howe and Hibbard Systems.

Notice: This company controls the Howe and Hibbard basic patents for the production of manganese steel in the electric furnace.

District Sales Offices:

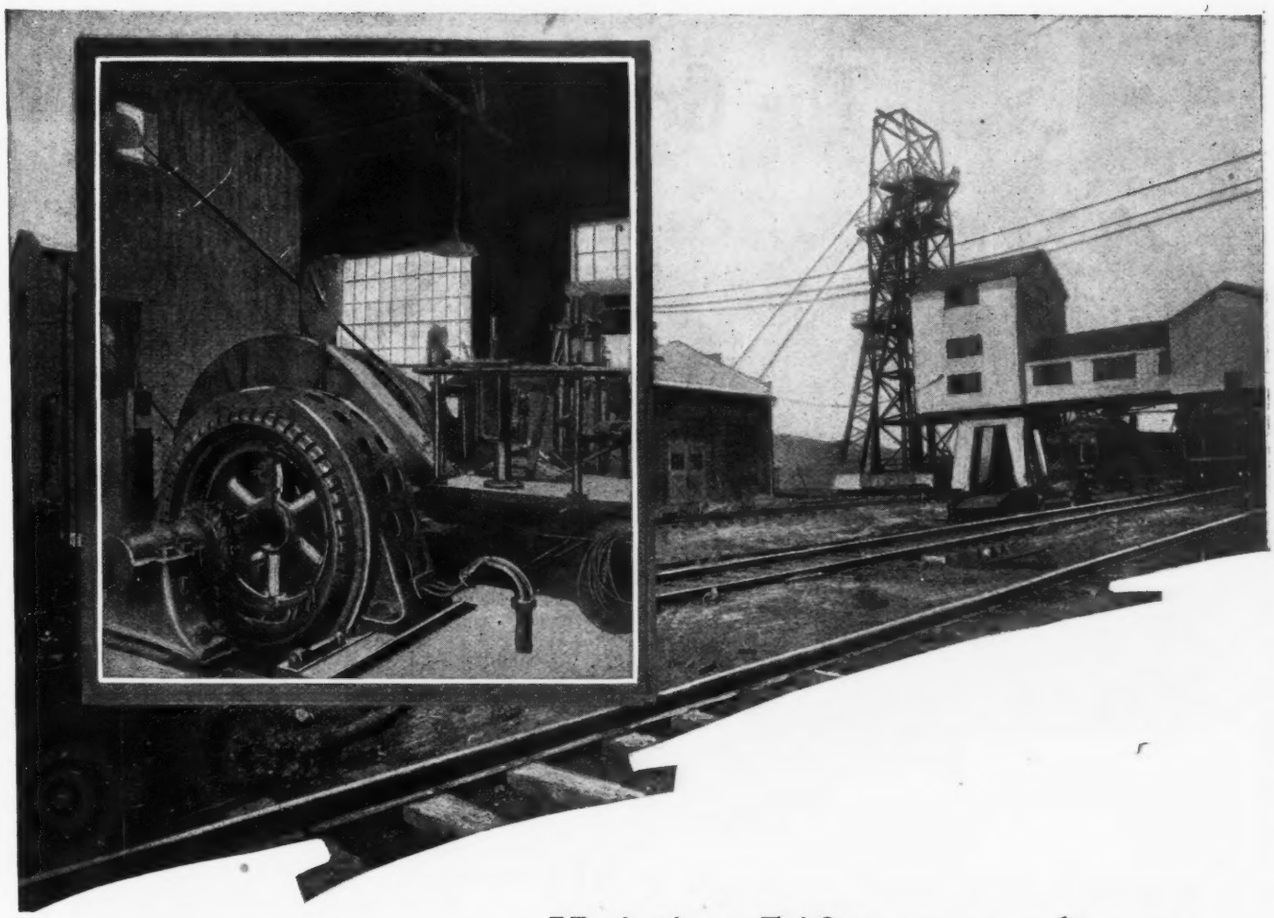
30 Church St., New York City
208 S. La Salle St., Chicago
1418 Oliver Bldg., Pittsburgh
713 Widener Bldg., Philadelphia
Denham Bldg., Denver
522 Connell Bldg., Scranton
201 Devonshire St., Boston
509 Insurance Exchange Bldg., San Francisco

Taylor Wharton Iron & Steel Co.
Plant at High Bridge, N. J.
Manganese Steel
Manganese Wearing Parts

Wm. Wharton Jr. & Co.
Plant at Easton, Pa.
Special Track Work
Cylinders for Gases

Tioga Steel & Iron Co.
Plant at Philadelphia, Pa.
Hammered and Pressed Forgings

Phila. Roll & Machine Co.
Plant at Philadelphia, Pa.
Rolls and Rolling Mill Machinery



Hoisting 540 tons per hour with a 700 h.p. Vulcan

At the mines of the Republic Collieries Company, a 700 hp. Vulcan Hoist is making a record for itself hoisting 540 tons of coal per hour, every hour of the working day.

This Hoist is equipped with a double cylindro-conical drum, oil tight gear guard and complete Vulcan Safety Devices. The weight of the cage is 13,000 lbs.; the car, 3,500 lbs.; and the load, 6,000 lbs.; 11¼ tons total. Rope speed 1700 f.p.m.

Particulars on our full line of Electric and Steam Hoists, our special Vulcan Safety Devices, should be on your desk.

Other Vulcan Equipment

- Steam Locomotives
- Gasoline Locomotives
- Rotary Kilns, Dryers, Coolers and Roasters
- Mine Ventilating Fans
- Cages and Skips
- Sheave Wheels
- Corliss Engines
- Coal Crushers and Rolls
- Gray Iron Castings
- Open Hearth Steel Castings
- Gears, Moulded and Cut Teeth
- Special Machinery

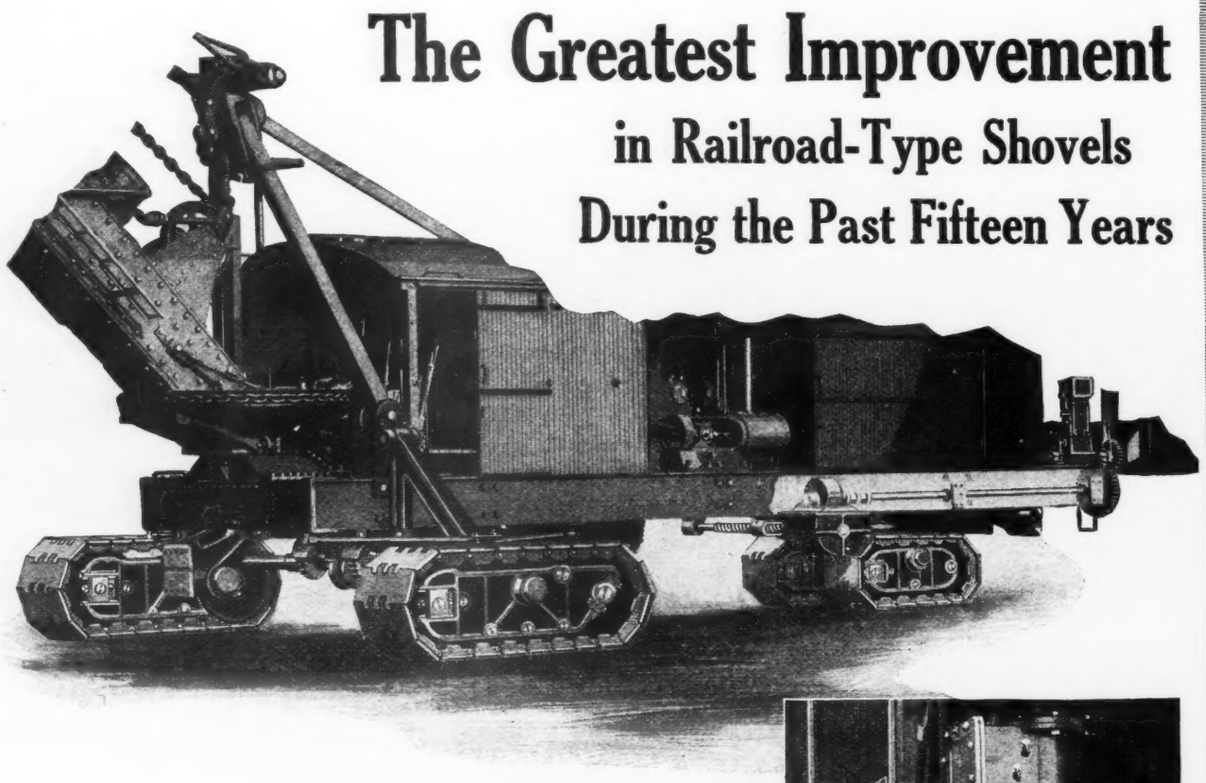
VULCAN IRON WORKS

Established 1849

1733 Main Street, Wilkes-Barre, Pa.

VULCAN OF WILKES-BARRE HOISTS

The Greatest Improvement
in Railroad-Type Shovels During the Past Fifteen Years

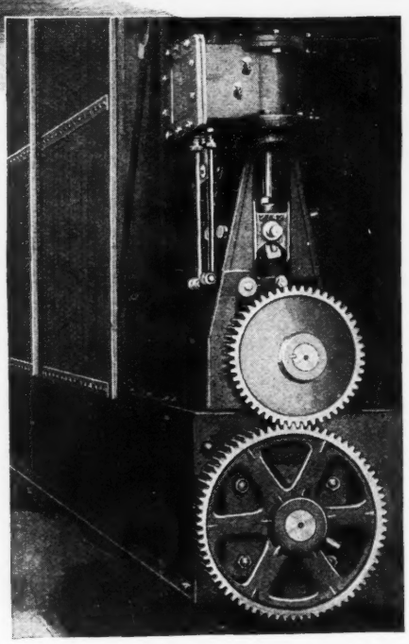


MARION Crawler Trucks are now perfected to such a degree that we can genuinely urge the abandonment of other types of mounting for railroad-type shovels. The inefficiency of common labor, combined with the high cost of track materials—ties, rails and jack blocks, and the resultant loss of time due to slower move-ups makes these new trucks especially desirable and economical.

Forward trucks can be propelled independantly or together. They have plenty of power and traction to move without slipping or miring. They have wide face and ample bearing. Pads and side frames are open hearth steel castings annealed and heat treated.

The rear truck is a single unit set under the center of the shovel. It is arranged to swivel in either direction and will easily adjust itself to rough or uneven bottoms. The three point support of the "crawler" trucks prevents twisting of the car body or binding of the shafts and machinery parts.

Full details of these new trucks will be gladly sent on request.



Steering Engine is set on deck along-side of boiler, not underneath the car body where it is difficult to adjust and where water, ice and dirt can easily collect. Engine is connected to rear truck through series of shafting and gears, which permit turning the trucks in either direction.

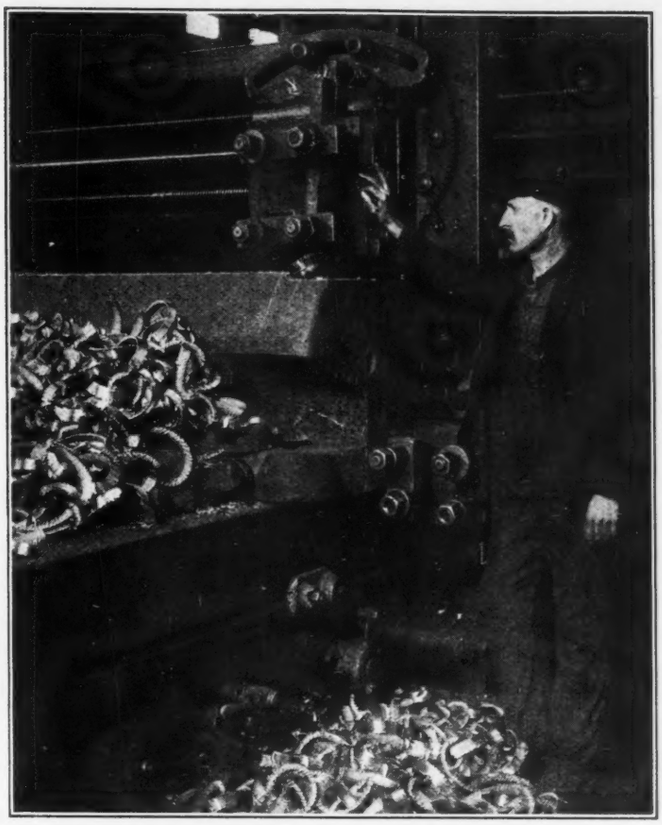
267

The Marion Steam Shovel Company
Marion Ohio.

Marion Crawler Trucks Make Hard Going Easy

MIDVALE

EXTRA HIGH SPEED TOOL STEEL



Where Quality Means Quantity

A Midvale Extra High Speed roughing tool 2 inches by 3 inches taking a 1 inch cut, $\frac{1}{4}$ inch feed at 16 feet per minute.

Midvale Tool Steel produces prodigious quantities of chips per unit of time. For "hogging" this steel removes the maximum amount of metal with the least delay from tool changes.

Roll Shells **Hollow Drill Steel**

THE MIDVALE COMPANY

WORKS AND MAIN OFFICE:

NICETOWN,

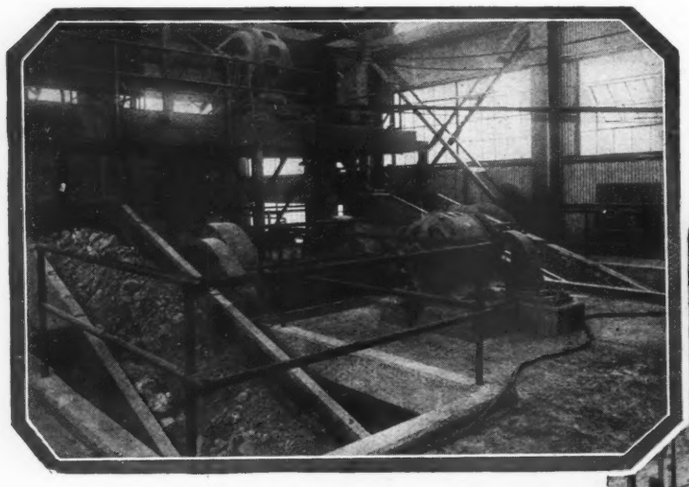
PHILADELPHIA, PENNSYLVANIA

District Offices:

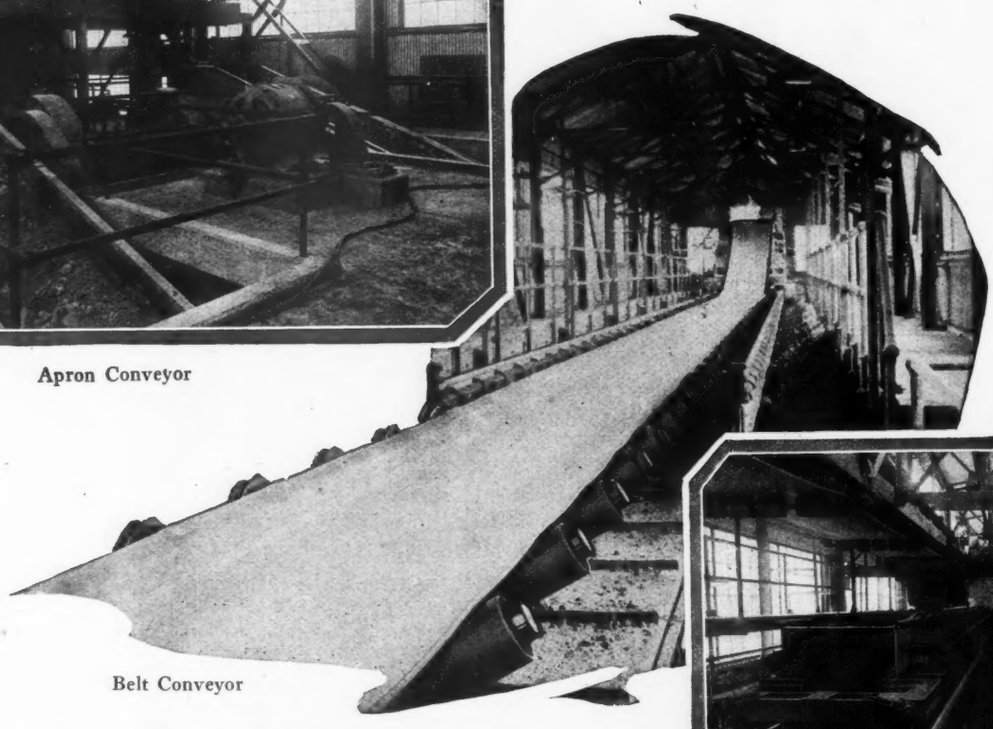
NEW YORK	CLEVELAND	CHICAGO	SAN FRANCISCO
165 Broadway	1006 Euclid Ave.	332 S. Michigan Ave.	681 Market St.

Tool and Alloy Steel Warehouses:

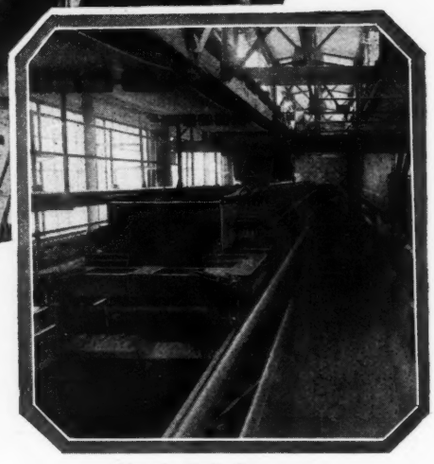
BOSTON PHILADELPHIA CLEVELAND CHICAGO SAN FRANCISCO



Apron Conveyor



Belt Conveyor



Shuttle Belt Conveyor

Serving in the Wonderful Sacramento Hill Project

Webster conveying equipment was chosen to serve in the wonderful Sacramento Hill project of the Phelps-Dodge Corporation at Bisbee, Arizona, because Phelps-Dodge engineers knew it would give dependable and economical service — just what the mining industry demands in mine equipment.

And we appreciate the opportunity given us to play a role in this important project and feel a pride in the confidence placed in Webster equipment.

Webster equipment for ore concentrating and smeltering plants is built ruggedly to withstand hard, severe usage. It is designed and made in our own up-to-date shops by skilled workmen and of the highest grade materials.

Our engineers have given years of time and study to conveying problems in this industry. Let them work with you on your next problem.

THE WEBSTER MFG. COMPANY

4500-4560 Cortland Street, CHICAGO

Branch Offices

BOSTON.....902 Oliver Bldg.
BUFFALO.....572 Ellicott Square
CINCINNATI.....1914 Union Central Bldg.
CLEVELAND.....509 Swetland Bldg.
NEW YORK.....90 West Street
PHILADELPHIA..719 Commercial Trust Bldg.

Factories

CHICAGO, ILLINOIS TIFFIN, OHIO

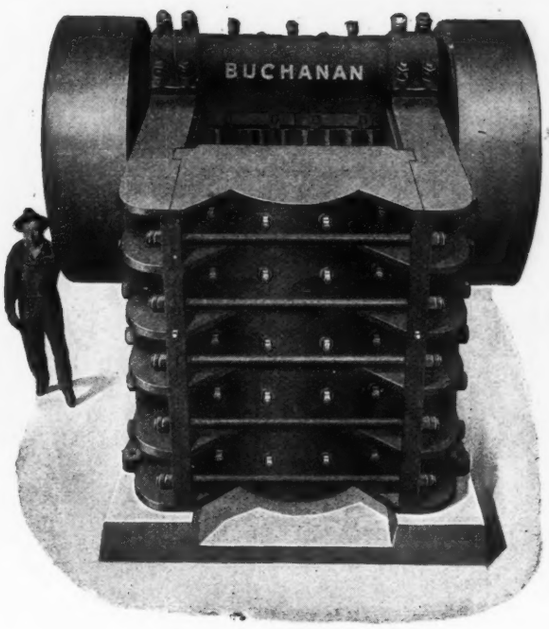
Agencies and Representatives

Atlanta, Ga.....Fulton Supply Co., 70 Nelson St.
Baltimore, Md..H. W. Faunt LeRoy, 523 Calvert Bldg.
Birmingham, Ala...G. R. Mueller, Brown-Marx Bldg.
Denver, Colo.....C. L. Dean, 1718 California Ave.
Detroit, Mich., Palmer-Bee Co., 2778-2794 E. Grand Blvd
Knoxville, Tenn...Webster & Co., Holston Bank Bldg.
Louisville, Ky...E. D. Morton & Co., 516 W. Main St.
Memphis, Tenn..E. C. Atkins & Co., Maine & Butler Sts.
Milwaukee, Wis....W. Clasmann Co., 620 Wells Bldg.
New Orleans, La., Globe Supply & Machinery Company, 625-627 S. Peters Street.
Pittsburgh, Pa...Dempcy-Degener Co., 708 Penn Ave.
Salt Lake City, Utah, L. W. Mendenhall, 517 McIntyre Building.
Salt Lake City, Utah.....Gallgher Machinery Co.
Seattle, Wash., The Brinkley Company, 651 Alaska St.
Vancouver, B. C...B. C. Equipment Company, Ltd., 613 Bank of Nova Scotia Bldg.

Canadian Factory - Sales Office: WEBSTER - INGLIS, LIMITED, 14 Strachan Ave., Toronto, Ont.

Why do big Companies Choose BUCHANANS?

Because when the annual report is made to stockholders, the big *important* thing is *production*—production depends on crusher operation—and Buchanans insure



Greater Productions Lower Upkeep

Continuous production, year after year—as one user aptly states: "We are all agreed that the Buchanan Crusher is, from a mechanical point of view the only real machine we have got." There's a Buchanan that will exactly meet your requirements. All standard sizes fully described in bulletins.

A Suggestion to your advantage:

Check the literature you would like on coupon below and mail today

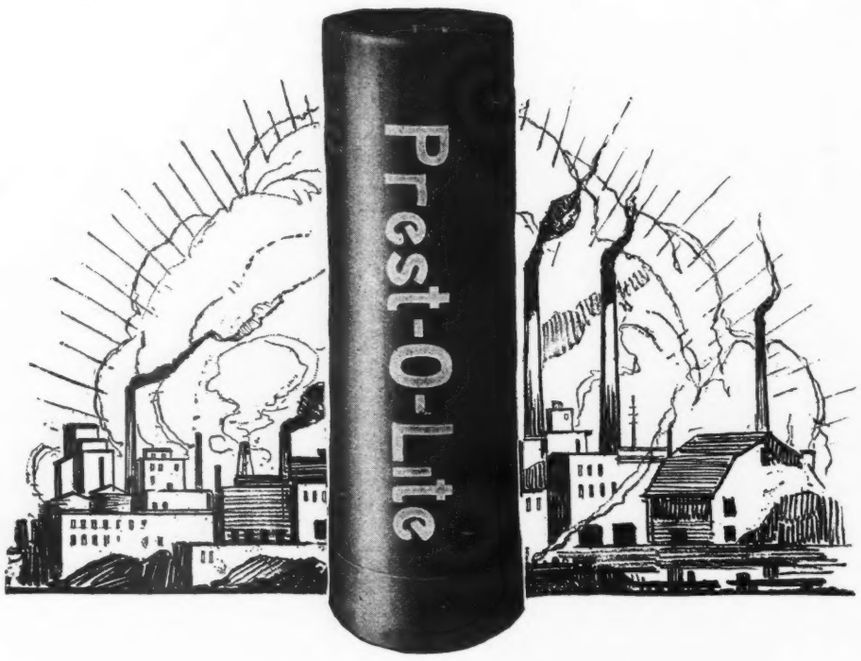
C. G. Buchanan Co., Inc., West and Cedar Sts., New York City.

Gentlemen:—Please send without obligation

☐ Bulletin 10—Large Crushers. ☐ Bulletin 9—Small Crushers.

☐ Bulletin 13—Crushing Rolls. ☐ Bulletin 14—Magnetic Separators and Pulleys.

Name..... Address.....



Meeting the Demand

To meet the constantly growing demand for Prest-O-Lite service, Prest-O-Lite's cylinder factory is distributing an ever-increasing number of new cylinders.

Years of experience in the manufacture and distribution of Dissolved Acetylene has established a high standard for every Prest-O-Lite cylinder—a standard that Prest-O-Lite unfailingly maintains by making its cylinders to its own design and under its careful supervision.

An inquiry at our nearest sales office will bring you information concerning our latest sales and service plans.

Each Prest-O-Lite user looks to his nearest District Sales Office not merely for arrangements to adequately cover acetylene needs, but for helpful co-operation and advice on any matter involved in the use of acetylene.

THE PREST-O-LITE COMPANY, INC.

General Offices: Carbide and Carbon Bldg., 30 E. 42nd St., New York City

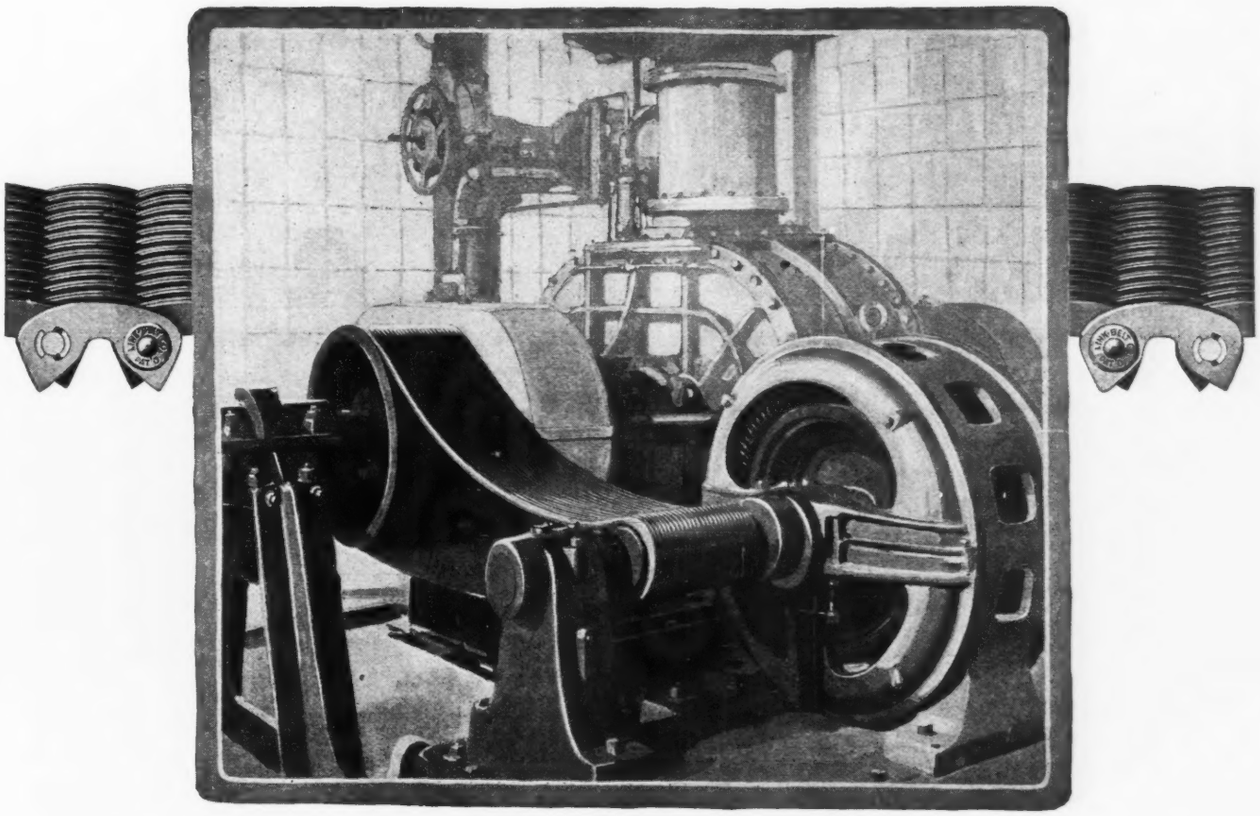
In Canada: Prest-O-Lite Co. of Canada, Toronto

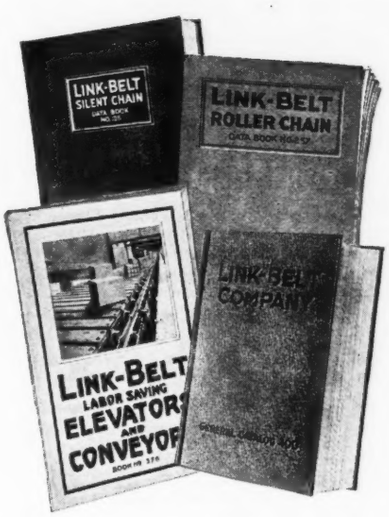
District Sales Offices

Atlanta	Chicago	Detroit	New Orleans	Pittsburgh
Baltimore	Cleveland	Kansas City	New York	San Francisco
Boston	Dallas	Los Angeles	Philadelphia	Seattle
Buffalo		Milwaukee		St. Louis

Prest-O-Lite

DISSOLVED ACETYLENE





You can do much to inform yourself on elevating, conveying and power transmission methods and equipment by reading these books. Sent gratis on request.

Chain the Motor to the Machine

DON'T waste power—

Drive your machine and line-shafting with this 98.2% efficient Link-Belt Silent Chain Drive.

It is flexible as a belt—positive as a gear—more efficient than either.

It has earned an enviable reputation as the "Ideal" Drive in all lines of power transmission. And when enclosed in our patented oil-retaining, dust-proof casing it makes a real "safety-first" factory drive for machine tools, pumps, blowers, compressors; in fact, for every type of machine.

We sell each drive complete, and guarantee its performance.

Let our experienced power transmission engineers show you how to use this compact and efficient drive in your work.

The books illustrated will give those interested a good idea of the entire Link-Belt line of chains and elevating and conveying machinery. Copies sent on request.

1410-A

LINK-BELT COMPANY

PHILADELPHIA
2045 Hunting Park Ave.

CHICAGO
300 W. Pershing Road.

INDIANAPOLIS
501 N. Holmes Ave.

Branches in Industrial Centers

LINK-BELT
SILENT CHAIN DRIVES

SEARCHLIGHT SECTION

USED EQUIPMENT & NEW—BUSINESS OPPORTUNITIES

UNDISPLAYED—RATE PER WORD:

Positions Wanted, 4 cents a word, minimum 75 cents an insertion, payable in advance.

Positions Vacant and all other classifications, 8 cents a word, minimum charge $2.00.

Proposals, 40 cents a line an insertion.

INFORMATION:

Box Numbers in care of any of our offices count 10 words additional in undisplayed ads.

Discount of 10% if one payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED—RATE PER INCH:

1 to 3 inches.....$4.50 an inch
4 to 7 inches..... 4.30 an inch
8 to 14 inches..... 4.10 an inch

Rates for larger spaces, or yearly rates, on request.

An advertising inch is measured vertically on one column, 3 columns—30 inches—to a page.

E.&M. J.-P.

POSITIONS VACANT

ENGINEER as Superintendent of Mechanical Maintenance and Construction wanted. Must be familiar with underground operations, and have had experience in construction and maintenance of large mills and concentrators. P-902, Engineering & Mining Journal-Press, Real Estate Trust Bldg., Phila., Pa.

SALES engineer for underground loading machines; must have experience in mining or with mining machinery and acquaintance with mining companies who can or now use mechanical loaders. P-909, Eng. & Min. Journal-Press, Leader-News Bldg., Cleveland, Ohio.

SUPERINTENDENT for large property in Colorado. Must be familiar with large deposits of disseminated ores and fissure vein system mining. Preferably, experienced in mining and milling operations of zinc-lead ores. Advancement assured right man. P-906, Engineering & Mining Journal-Press, Old Colony Bldg., Chicago, Illinois.

EMPLOYMENT SERVICE

SALARIED men seeking tentative offers of new connections, are invited to communicate confidentially with the undersigned, who will negotiate overtures without jeopardy to present connections. A professional, ethical service, restricted to high grade positions; established 1910. Our "Refund Contract" guarantees refund of retaining fee to the client named therein, if service is not satisfactorily rendered and refund be requested within three months from date remitted. Send name and address only for particulars. R. W. Bixby, Inc., 704 Lockwood Building, Buffalo, New York.

EXECUTIVES, engineers and other qualified men whose salary requirements are over $2,500 per year find our confidential direct service to specific employers extremely satisfactory. An inquiry entails no obligation. The National Business Bourse, Inc., H. H. Harrison, President, Association Bldg., Chicago.

POSITIONS WANTED

CHEMIST and Chemical Engineer, eight years experience as chemist, superintendent and plant manager in various industries. Capable of designing, working out, installing and operating chemical processes. Will be open for engagement on or before February. PW-896, Engineering & Mining Journal-Press, Real Estate Trust Bldg., Phila., Pa.

Employment Service

Engineers, Mining and Technical Men

Placed with Engineering, Mining, Oil, Coal, Construction, Power, Electric, Chemical, and all Industrial Enterprises.

PHELPS OCCUPATIONAL BUREAUS, INC.

Suites 230-31-32 U. S. Nat'l Bank Bldg.
Denver, Colorado

NEW YORK OFFICES
Bush Terminal Sales Bldg., 130 W. 42nd St.
On and After May 1st

Employees Placed Everywhere. Representatives Furnished Everywhere. Manufacturers Goods Marketed Everywhere.

Cable Address: "Actbureaus"
Denver and New York

In Replying to "Blind" Ads

be careful to put on envelope the key number in the ad and also local address of office to which reply is sent.

10th Ave. at 36th St., New York.
509 Real Estate Trust Bldg., Phila.
359 Leader-News Bldg., Cleveland.
1570 Old Colony Bldg., Chicago.
Mohr Bldg., San Francisco

Important

Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents — send copies.

0195

POSITIONS WANTED

CHEMIST, metallurgist, American; age 30; expert all branches analytical chemistry; skilled in precious metal refining, platinum a specialty; two years a U. S. government chemist. Experience covers industrial and metallurgical work in Mexico, Cuba, Puerto Rico and United States. Spanish. Position wanted would be that of chief chemist with a concern appreciating solving of operation problems and reduced costs. Employed; available thirty days. PW-911, Eng. & Min. Journal-Press, 10th Ave. at 36th St., New York.

COLUMBIA graduate, thirteen years' experience with large and small companies. Broad underground training. Now superintendent. Fluent Spanish. PW-895, Eng. & Min. Journal-Press, 10th Ave. at 36th St., New York.

DOCTOR, single, sober, good health; speaks Spanish; thirteen years' experience; five years' mining practice in Mexico; wants position with mine or smelter. Address Dr. B. O. Thrasher, 614, N. Oregon St., El Paso, Texas.

EXECUTIVE, graduate engineer, with business training and twenty years' experience in examinations and operating of large and small properties with a record in efficiencies and costs, desires engagement with reliable company; interview New York or vicinity. PW-907, Eng. & Min. Journal-Press, 10th Ave. at 36th St., New York.

GRADUATE engineer, from Missouri School of Mines, desires position as Manager or Superintendent with a mining or smelting enterprise in this country or Mexico. Have had eight years experience in Mexico and nine years in this country. American, 39 years of age, married. Best of references. Salary commensurate with position on a make good basis. PW-903, Engineering & Mining Journal-Press, 883 Mission St., San Francisco, Calif.

MINING Engineer with fifteen years experience desires position with responsible company requiring part or whole time in travel, domestic or foreign, selling or examinations. Best references. PW-901, Engineering & Mining Journal-Press, Leader-News Bldg., Cleveland, Ohio.

MINING Engineer with fifteen years executive experience, Canada and United States, desires connection with responsible mining company January first. J. R. Thoenen, Sault Ste. Marie, Mich.

ORE-metal-mineral buyer and salesman, also expert mining and railway auditor and manager, wide experience in U. S. A. and Spanish America, fluent Spanish. Desires traveling or resident connection, no salary and commission or division of profit arrangement entertained that will not net more than ten thousand dollars yearly to able negotiator. L. C. Butler, 2573 Amboy Road, New Dorp, S. I., New York.

RECENT mining graduate; one year's experience; single; will go anywhere. PW-910, Eng. & Min. Journal-Press, 10th Ave. at 36th St., New York.

WOULD like to locate with a mining company or machinery manufacturing company who can use a good mechanical designing engineer on layout work and supervision of drafting office. PW-908, Eng. & Min. Journal-Press, 883 Mission St., San Francisco, Calif.

BUSINESS OPPORTUNITIES

Partner Wanted

A partner wanted to go prospecting. Address 2193 East Figueroa Street, Santa Barbara, Calif.

Interest in Gold Mine

If you would like an interest in a gold mine with plenty free milling gold ore. Write Box No. 86, Newport, R. I.

WANTED

High Grade Salesmen and Sales Agents

capable of representing a nationally known quality brand of technical Paint Specialties, exclusively or in conjunction with some other line, on a strictly commission basis. Full information as to experience, present connections and references required.

AS-887 Engineering & Mining Journal-Press
Tenth Ave. at 36th St., New York City

FOR SALE

SILVER MINING PROPERTY

In Austin, Nevada, consisting of approximately 1200 acres, one-half of which are patented. Last owned by Austin-Manhattan Consolidated Mining Co. Includes old mines of the MANHATTAN MINING Co., with record production of over TWENTY MILLION DOLLARS. None of the old mines are deep.

WM. A. MARSHALL
Resident Agent, Austin, Nevada

For Student or Prospector

60 Mineral and Rock specimens of more important minerals and rocks. Label attached. Fine oak cabinet with compartments included. Price $8.50 delivered. Collection 125 most important minerals $17.50. I purchase Mineral Specimens.

GEORGE S. SCOTT.
342 Madison Ave., New York.

Mine Owners and Operators

If you do not employ a geologist regularly, let me explain in detail.

A NEW PLAN FOR MINE GEOLOGIC SURVEYS

Write to J. H. FARRELL
315 Montgomery St., San Francisco, Calif.

FOR SALE

TRAMWAY

Four thousand foot complete. Leschen Heavy Duty Friction Grip System. Capacity 50 tons per hour at speed of 500 feet per minute. Equipment includes 4075 ft. of 1⅝-in. locked coil cable, 8415 ft. ¾-in. cast steel traction rope, 30 buckets, equipment for loading and discharge terminals, etc. Full description upon request. A real bargain.

United Verde Extension Mining Company
Jerome, Arizona

NEW AND REBUILT

Mining and Milling Machinery

Send for Complete List

Agents for:
Allingham Flotation Machines
Plymouth Locomotives
Buchanan Jaw Crushers

Rosenburg & Co. Machinery Los Angeles

Rosenburg & Co.

3rd & San Pedro Sts. Los Angeles, Cal.
8th Madison & Jackson Sts. Phoenix, Arizona

FOR SALE

CARS AND TRACK

I have 9000 ft. of 24-in. gauge, 20 lb. riveted track, 15-ft. sections—20 running gears, 4-ton capacity with roller bearings—All new—San Francisco Stock.

Write or wire
H. A. OLDS
50 Fremont St., San Francisco

MACHINERY FOR SALE

CRUSHERS

1—9x15 Denver Eng. Works Blake Crusher.

1—9x15 Davis Blake Crusher.

These two machines guaranteed in first class condition, f.o.b. cars Breckenridge, Colorado.

The Royal Tiger Mines Company
Tiger, Colorado

BARGAINS

New and Used Machinery

BALL MILLS

2—6x8-ft. Standard Ball Mills.
1—6x6-ft. Allis-Chalmers Ball Mill.
1—5½-ft. Standard Ball Mill, new.
2—5x4-ft. Standard Ball Mills, new.
1—4x3-ft. Standard Ball Mill, new.
1—3x3-ft. Standard Ball Mill, new.

TUBE MILLS

2—5x22-ft. Allis-Chalmers, Steel Lined.
1—5x14-ft. Allis-Chalmers, Silex Lined.
1—6x12-ft. Allis-Chalmers, Silex Lined.

CRUSHERS

1—15x24 Blake Crusher.
3—13x24 Blake Crushers.
1—10x20 Blake Crusher.
2— 9x15 Blake Crusher.
2— 9x15 Dodge Crushers.
3— 7x11 Dodge Crushers.
1— 7x10 Blake Crusher.
1— 5x10 Blake Crusher.

CRUSHING ROLLS

2—Sets 42x16 Colorado Iron Works.
4—Sets 40x16 Colorado Iron Works.
2—Sets 36x16 Denver Engineering Works.
3—Sets 36x16 Davis.
2—Sets 30x14 Power & Mining Mchy. Co.
3—Sets 27x14 Davis.
2—Sets 27x14 McFarlane.
2—Sets 24x14 Chicago Iron Works.
2—Sets 16x10 McFarlane.

MOTORS

3 phase, 60 cycle, 440 volts

1—225-hp. General Electric, 900 r.p.m.
1—200-hp. Westinghouse, 580 r.p.m.
1—100-hp. General Electric, 900 r.p.m.
1— 75-hp. General Electric, 720 r.p.m.
1— 50-hp. Westinghouse, 900 r.p.m.
1— 50-hp. Allis-Chalmers, 1200 r.p.m.
1— 50-hp. Fairbanks-Morse, 1800 r.p.m.
1— 35-hp. Fairbanks-Morse, 1200 r.p.m.
2— 30-hp. Westinghouse, 1200 r.p.m.
1— 20-hp. Crocker-Wheeler, 900 r.p.m.
1— 15-hp. Crocker-Wheeler, 1200 r.p.m.
1— 15-hp. Westinghouse Hoist Motor.
1— 10-hp. Westinghouse, 1200 r.p.m.
1— 10-hp. Crocker-Wheeler, 1800 r.p.m.
1— 5-hp. Westinghouse, 1200 r.p.m.

Full specifications and prices sent on request.

Write Today

Morse Bros. Machinery & Supply Company
1750 Wazee St., Denver, Colo.

FOR SALE CHEAP

HANCOCK JIGS

Due to changed Mill Flow Sheet, 6 brand new 19-ft., complete. Apply

FS-912, Engin'g and Mining Journal-Press
883 Mission St., San Francisco, Calif.

Is Your Drinking Water Impure?

Natural Tripoli Filter-Stones solve most of these problems.

Write for Descriptive Matter and Prices.

AMERICAN TRIPOLI COMPANY
(Incorporated 1892)
Seneca, Mo., U.S.A.

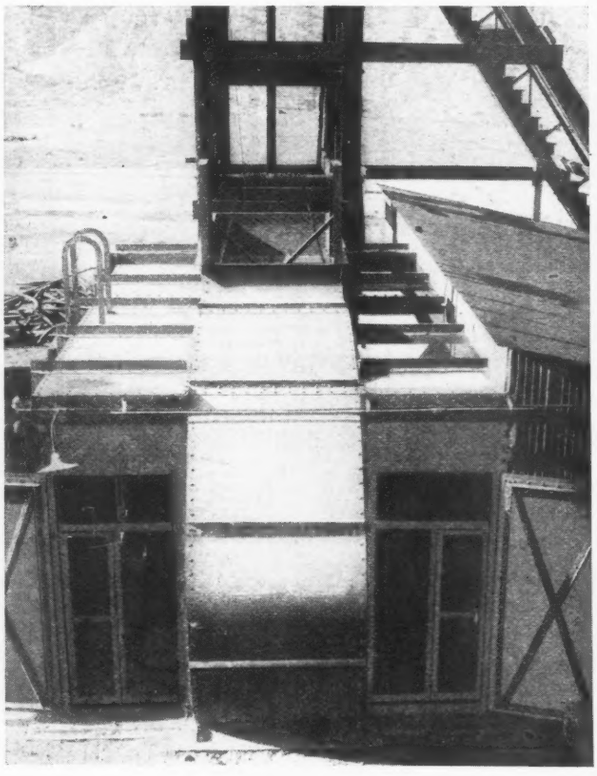
Thyle Machinery Co.
formerly
A. H. SIMPSON CO.
Rebuilt Machinery
129 Fremont St., San Francisco

Is There A Blast Furnace Near You?

CERTAINLY there's a market for scrap iron — steel plants buy it. But why let that old hoist, sinker pump, station pump, boiler, or any other machinery which is not in use rust out and become scrap, or take up room indefinitely in your storehouse while waiting for some local operator to buy it.

Advertise your surplus machinery. You know its worth; tell others. There's someone who needs just that type of machine and SEARCHLIGHT can find him for you. Write for information.

"SEARCHLIGHT" Service
Secures Satisfactory Sales



Supply the breath of life for the men at the Old Dominion Mine

Two Sturtevant Mine Fans are installed at the Old Dominion Company's mine, Globe, Arizona. One has been on the job for eight years and one for three months.

The fact that a second fan was installed after eight years' continuous duty of the first one is ample proof of the sort of service rendered.

Sales engineering offices and direct representatives in every commercial center of the world.

Plants located in
Hyde Park, Mass.
Framingham, Mass.
Sturtevant, Wis.
Berkeley, Calif.
Camden, N. J.
Galt, Ontario

Sturtevant Mine Fans are in use in metal mines in all parts of the United States. We'll be glad to give you particulars and advise you on the fan best suited to your conditions.

B. F. Sturtevant Co.
Hyde Park, Boston, Mass.

Sturtevant
PUTS AIR TO WORK
797

WEDGE ROASTING FURNACES
(Patented)

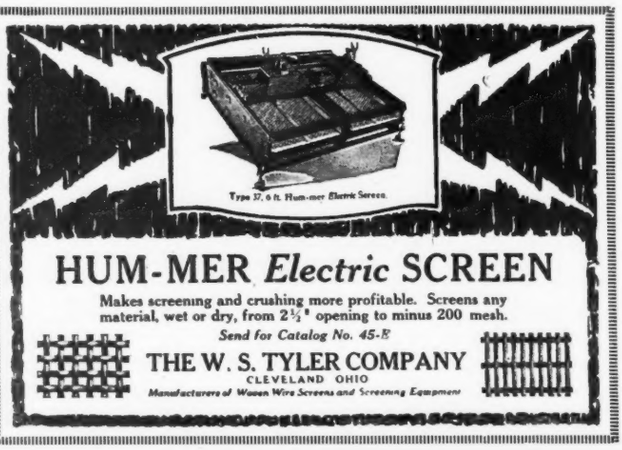
For Best Metallurgical Results and Economical Operation

Send for Catalog F-1

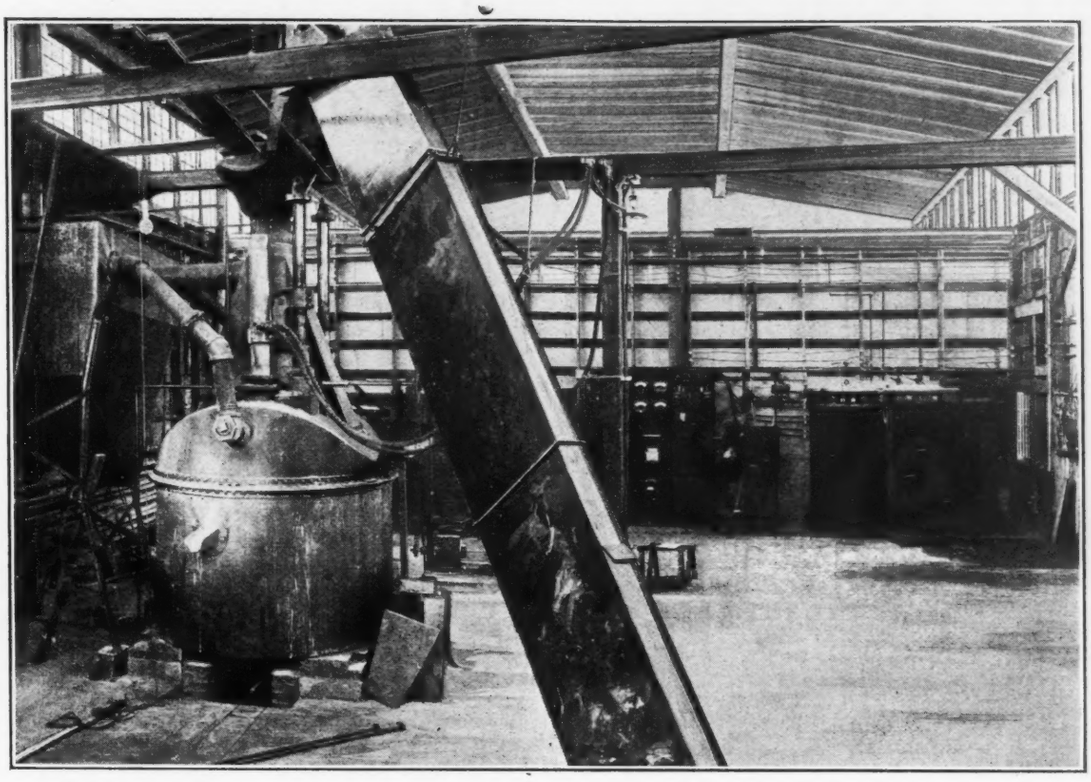
Bethlehem Foundry & Mach. Co.
Wedge Furnace Dept.,
Bethlehem, Pa.

PERFORATED METAL SCREENS
for Every Purpose
Elevator Buckets
Light and Heavy Steel Plate Construction
HENDRICK MFG. CO., Carbondale, Pa.
New York Office 30 Church St. | Hazleton, Pa., Office 705 Markle Bank Bldg. | Pittsburgh, Pa. 544 Union Trust Bldg.

SCREENS OF ALL KINDS
Chicago Perforating Co.
2445 West 24th Place
Tel. Canal 1459 CHICAGO, ILL.



HUM-MER *Electric* SCREEN
Makes screening and crushing more profitable. Screens any material, wet or dry, from 2½" opening to minus 200 mesh.
Send for Catalog No. 45-E
THE W. S. TYLER COMPANY
CLEVELAND OHIO
Manufacturers of Woven Wire Screens and Screening Equipment



The Slag Resistance Principle

ONE of the features responsible for the efficiency of the Wile Electric Ore Smelting Furnace is the slag resistance method of melting.

The heat is generated by the resistance of the slag to the path of the current. By lowering the electrodes, the path of the current is shortened: the resistance becomes lower and the temperature greater. By raising the electrodes, the contrary becomes the case.

Thus an even temperature may be maintained in all parts of the furnace, resulting in lower slag losses and purer metal.

Booklet "T" describes this principle in detail and gives other interesting information concerning this furnace.

WILE ELECTRIC FURNACES

WILE ELECTRIC FURNACE & ENGINEERING CO.

50 Church Street, New York City

Cable Address—Wilefurn, New York

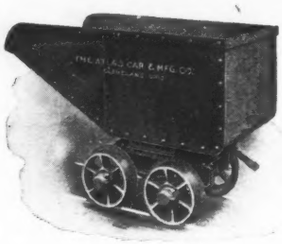
ATLAS Is Prepared to Build Your Specially Designed Equipment

No. 6425
Electric Locomotive

No matter what your haulage problems, Atlas is prepared to solve them. Our files are full of drawings for special equipment. Our staff of engineers, with years of experience back of them, is at your service.

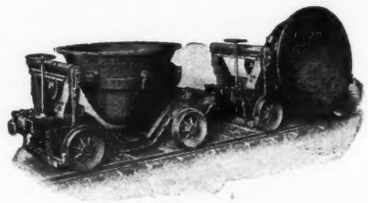
The ATLAS Car & Mfg. Co.
Cleveland, Ohio

Engineers *Manufacturers*

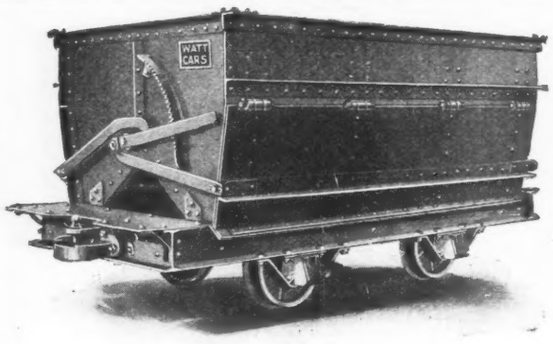


No. 261
Standard Scoop Car, rotary

No. 173
End Rocker Dump Car, with brake, large capacity



No. 194
Hot Metal or Ladle Car



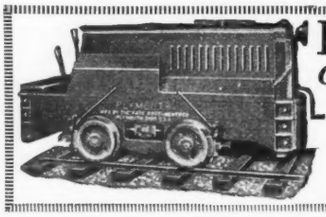
Builders of

GOOD CARS

Since 1863

— Catalogs —

The
WATT
MINING CAR
WHEEL CO.
Barnesville,
Ohio



PLYMOUTH
Gasoline Locomotives
For Mine and
Industrial Haulage
Ask for Bulletins
THE FATE-ROOT-HEATH CO.
Plymouth, Ohio, U. S. A.

GASOLINE STORAGE BATTERY TROLLEY COMBINATION
WHITCOMB LOCOMOTIVES

Decrease Haulage Costs
— WRITE FOR CATALOG —
Geo. D. Whitcomb Company
ROCHELLE — ILLINOIS
SEE OUR ADVERTISEMENT IN THE FIRST ISSUE OF EACH MONTH

Western Dump Cars

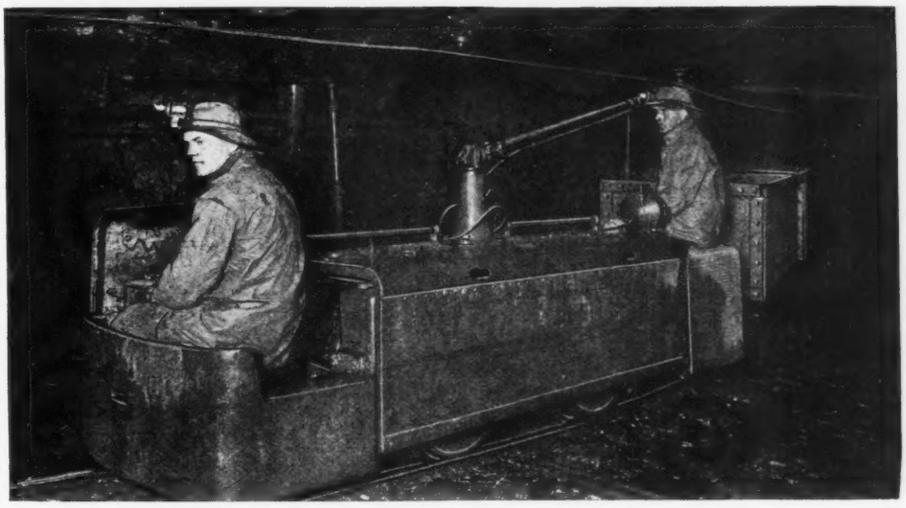
For stripping and handling low-grade ore Western Dump Cars have no equal. Made for Hand and Air Dumping in all practical sizes, there is a Western for every use.

Western cars are in service all over the world from the Mesaba Iron Range to Katanga, Africa. Their durability and efficiency make them invaluable to mine operators.

Let us send you our latest Catalog

Western

Western Wheeled Scraper Company
Earth and Stone Handling Equipment
Aurora, Illinois



Hundreds of Goodman Locomotives

In the Lake Superior District

It must *mean* something, this popularity of Goodman locomotives on the iron and copper ranges of Michigan, Wisconsin and Minnesota—a popularity which amounts almost to Standardization.

It means that Goodman Metal Mine Locomotives are built expressly for Metal Mine Duty—designed *in principle* and *in detail* to meet exactly the service conditions.

It means that the variety of types, weights and equipment available in the Goodman Line makes possible a "perfect fit" in suiting the locomotive to the local requirements.

In the "MS" type, for example, there is *in principle* the unit drive for all four wheels, which assures maximum possible pulling power per ton of weight; and *in detail* the completely dirt-proof and water-tight enclosure of all working parts.

There is also *in principle* the facility for heavy hauling of full loads at good speeds; and *in detail* the ease of short moves and car spotting at loading chutes.

Again *in principle* a minimum number of working elements, all generous in size and rugged in character; and *in detail* a ready accessibility to every part, for inspection, lubrication, adjustment or replacement.

Goodman Service Follows Every Goodman Locomotive.

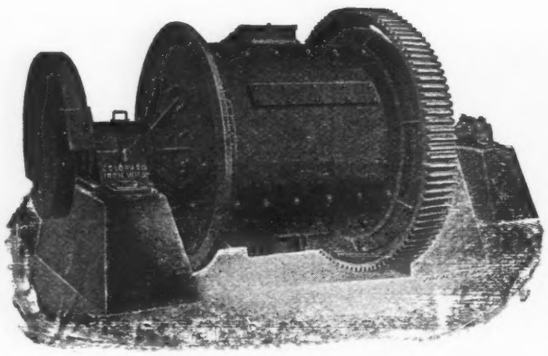
(52)

GOODMAN MANUFACTURING COMPANY

PITTSBURGH CHARLESTON, W.VA. ST. LOUIS DENVER

4746 to 4854 South Halsted Street CHICAGO, ILL.

CINCINNATI HUNTINGTON, W.VA. BIRMINGHAM



Flexibility of Operation

Colorado
Ball
Mills

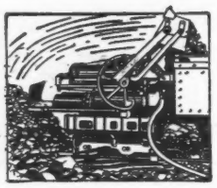
QUEEN CITY
MANGANESE
CHROME
CARBON STEEL CASTINGS

The Colorado Ball Mill convertible discharge gives a flexibility of operation that means highest milling efficiency with the greatest capacity.

Colorado Ball Mills are built right in every particular. The heavy shells and heavy heads and trunnions give it strength to meet the most severe conditions. Colorado Ball Mills are made in a variety of sizes, and driven in various ways. Write for pamphlet No. 31-A.

Colorado Iron Works Co.
Denver, Colo.
New York Office: 30 Church Street
Head, Wrightson & Co., Ltd., 5 Victoria St., Westminster, London, S. W. 1, England

Speeds up work
Shuveloader
"The mechanical mucker"



For tunnels, crosscuts, drifts and stopes. Saves time. Saves money.

Write for Catalog 4-E

Lake Superior Loader Company
Duluth, Minnesota

BROWNHOIST

Locomotive Cranes
Grab Buckets
Belt Conveyors
Electric Hoists
Chain Conveyors
Overhead Tr. Cranes
Pillar and Jib Cranes
Heavy Dock Machinery

THE BROWN HOISTING MACHINERY CO.
Cleveland, Ohio

YUBA
GOLD DREDGES
Yuba Ball Tread Tractors. Yuba Centrifugal Pumps.
YUBA MANUFACTURING COMPANY
Works: Marysville, Cal. Sales Offices: 433 California Street San Francisco, Cal.

Use PLAT-O TABLES
For Ore Concentration and Coal Washing
DEISTER MACHINE CO.
Fort Wayne, Ind.

DREDGES FOR GOLD AND TIN
UNION CONSTRUCTION CO.
351 California St., San Francisco, Cal.
Neill Jigs—Union Churn Drills

DEISTER DIAGONAL DECK OVERSTROM
DEISTER-OVERSTROM
Diagonal-Deck Tables for Ore Concentration.
Leahy **NO-BLIND** Vibrating Screens.
THE
DEISTER CONCENTRATOR COMPANY
FORT WAYNE, INDIANA

For Better Milling Methods — MARCY BALL AND ROLLER MILLS, WILFLEY CONCENTRATING TABLES
For Assay & Laboratory Work — HEUSSER BALANCES, SAMSON CRUSHERS, McCOOL PULVERIZERS, CHEMICALS & SUPPLIES
For The Mine — MINING MACHINERY & SUPPLIES
THE MINE & SMELTER SUPPLY COMPANY
MANUFACTURERS & JOBBERS
DENVER SALT LAKE EL PASO NEW YORK SAN FRANCISCO

Standard Underground

Like the steam shovel on the surface the Hoar Baby Shovel is the standard underground. It can be lowered down the mine shaft without dismantling, is operated by one man, digs and loads from 100 to 200 tons per shift, trims and spots its own cars. Ask the Hoar Shovel Co., Inc., Duluth, Minn., to send complete information.

HOAR BABY SHOVEL

NEW YORK ENGINEERING CO.

2 RECTOR STREET NEW YORK CITY

Specialists in Gold, Tin, Platinum, Placer Engineering and Equipment

"Empire"

Gold Dredges

Hand Prospecting Drills

Hydraulic Gravel Elevators

Pipe Lines, Sluices, etc.

Caterpillar Mounting

Solves The Most Serious Problems of Railroad Type Shovel Operation

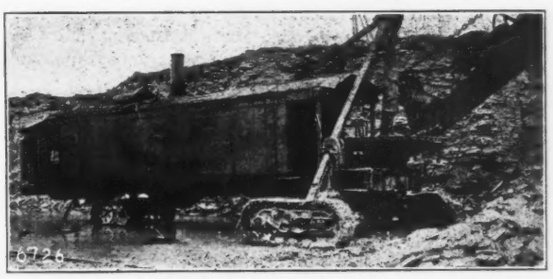
Two of the largest open cut mines in the world, after testing Bucyrus caterpillar mounting under railroad type shovels—have placed large repeat orders and plan eventually to mount all their shovels under

Bucyrus Caterpillar Mounting

It is estimated that the saving will amount to $25 to $30 per day per shovel and the output will be increased 10%.

A large number of Bucyrus Caterpillar Mountings have been sold in every part of this country and several countries and are operating under a great variety of conditions with complete success.

Send for caterpillar supplement Bulletin A-1-J



BUCYRUS

Established in 1880

A Special Plant Devoted Exclusively to Small Revolving Shovels

Railroad Type and Revolving Shovels of All Sizes, Dragline Excavators, Trench Excavators, Dipper, Hydraulic and Placer Dredges, Spreader Plows, Wrecking Cranes, Etc.

BUCYRUS COMPANY, South Milwaukee, Wis.

Birmingham New York Portland Chicago Denver San Francisco London Tokyo

547

WESTCO PUMPS
SHALLOW WELL

A Mine Owner, Who Uses WESTCO Pumps, Recently Made This Statement

"If only ten per cent of the engineers of this country knew what the WESTCO Pump would do for them you'd have to double the capacity of your plant to meet the demand of the mining industry alone."

The WESTCO is a suction—high pressure—single-stage pump which involves an entirely original and distinctive principle of pump design. Unusual results—pressure, volume, and simplicity are accomplished in WESTCO pumps—pressure without a multiplicity of close fitting, moving parts necessary in the piston pump—pressure and volume in single-stage unit which makes for greater simplicity than is found in the most simple centrifugal pump.

Every WESTCO pump has a wide range of pressures. Varying pressures within the range of an individual pump need not be predetermined and have but slight influence upon capacity.

In addition to being a rugged, compact and simple unit, the WESTCO is entirely without belts, valves, gears, or leathers. There is but one moving part.

A Wide Range of Uses

WESTCO Pumps are built in many sizes ranging in capacity from 5 to 200 gallons per minute and capable of operating against pressures up to two hundred pounds per square inch in a single-stage unit.

Their range of usefulness embraces all water supply problems and an infinite number of mining and industrial uses where liquids are handled by pump.

For mine or industrial installations where destructive chemicals are present we manufacture WESTCO Pumps of special metals which are positively impervious to the action of such chemicals.

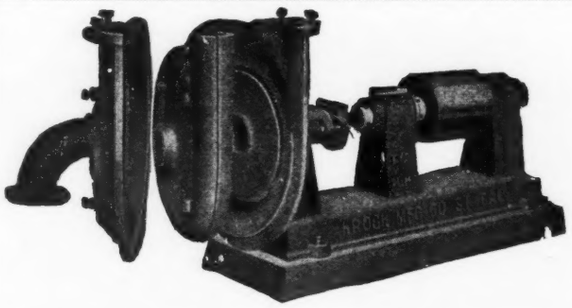
We also manufacture a complete line of CHIPPEWA Deep Well Pumps.

Write for full information to assist you in choosing the best pump for your purposes.

WESTCO-CHIPPEWA PUMP CO.

115 GAINES ST.
DAVENPORT, IOWA

CHIPPEWA PUMPS
DEEP WELL



Krogh *Sand Pumps*

Renewable liners and impellers of special chilled car-wheel iron (so hard that tool steel will not machine them) are important factors in the long life and economy of KROGH sand pumps.

Made in five standard sizes. All sizes operate at low speeds

Catalog No. 79 Describes and Illustrates Them.

Partial List of Users
Anaconda Copper Mining Co.
Alaska Treadwell Gold Mining Co.
Alaska Juneau Gold Mining Co.
Alaska Gastineau Mining Co.
Arizona Copper Co.
Beatson Copper Co.
Braden Copper Co.
Butte & Superior Mining Co.
Cananea Consolidated Mining Co.
East Butte Copper Mining Co
Mexican Corporation
Mond Nickel Co.
Miami Copper Mining Co.

Krogh Pump & Machy. Co.
147 Beale St., San Francisco

We are also manufacturers of Sinking Pumps — Centrifugal Pumps—Motor Driven Pumps and Dredge Pumps.

Catalogs sent on request.

NORDBERG
MACHINERY
NORDBERG
Uniflow Engines · Corliss Engines · Diesel Engines
Steam and Electric Hoists
Condensers · Compressors · Special Machinery
NORDBERG MANUFACTURING CO.
MILWAUKEE ... WISCONSIN

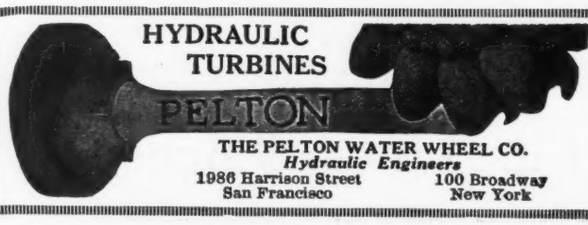
AIR AND GAS COMPRESSORS
VACUUM PUMPS

All Sizes All Types For All Pressures

No finer compressor made than a Bury Universal Variable Volume three-cylinder, two-stage Air Compressor. Why not investigate?
Send for Bulletin
Bury Compressor Company
1750 Cascade St., Erie, Pa.

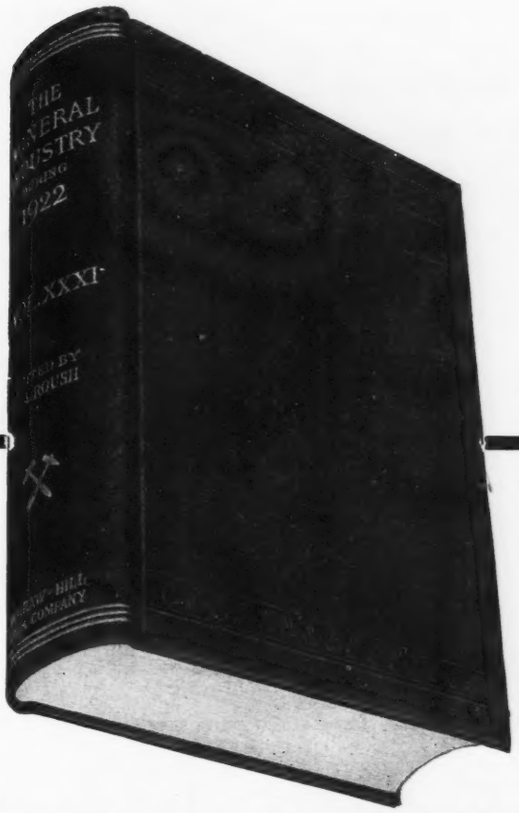
Pyramid Box Plate Valves "Durable as the Pyramids, Silent as the Sphinx"

MORRIS Since 1864
CENTRIFUGAL PUMPS
Since 1864 we have been building Centrifugal Pumps, Hydraulic Dredges and Steam Engines. You can *depend* upon the Morris reputation.
Morris Machine Works, Baldwinsville, N. Y.
Pittsburgh Office: Harris Pump & Supply Co.
Agents in Principal Cities



THE PELTON WATER WHEEL CO.
Hydraulic Engineers
1986 Harrison Street, San Francisco **100 Broadway, New York**

Always the *first* collection of reliable data in the mining and metallurgical fields



The international authority

The *Mining Journal* (London) says: "It is not too much to say that but for this leading review no general record of the industry would be available."

Metal Bulletin (London) says: "Of the annual volumes issued, dealing with developments in mineral and metal output, the MINERAL INDUSTRY takes first place."

A prominent professor of mining writes: "I have looked through the last volume and find it, as is always the case, what I consider the most valuable single book of reference on all the various mineral and metallurgical products."

MARSHALL S. WALKER, in a review in *Chemical and Metallurgical Engineering*, says: "It is a favor to the reading public not familiar with it to be informed regarding the MINERAL INDUSTRY. It is the only publication of its kind."

MINERAL INDUSTRY

Volume XXXI—Covering 1922

Edited by G. A. ROUSH,
Associate Professor of Metallurgy, Lehigh University,
and ALLISON BUTTS,
Assistant Professor of Metallurgy, Lehigh University.

911 pages, 6x9, $12.00 net, postpaid

MINERAL INDUSTRY is an international annual covering the statistics, technology and trade of the mineral industry throughout the world. It discusses in individual chapters, alphabetically arranged, sources of supply, statistics of production and consumption, exports and imports, and uses of all commercially important minerals.

CONTENTS

Abrasives
Aluminum and Bauxite
Antimony
Arsenic
Asbestos
Asphalt
Barium and Strontium
Bismuth
Borax
Bromine and Iodine
Cadmium
Cement
Chromium
Coal and Coke
Cobalt
Copper
Cryolite
Feldspar
Fluorspar
Fuller's Earth
Gold and Silver
Graphite
Gypsum
Iron and Steel
Lead
Magnesite
Manganese
Mica
Molybdenum
Monazite
Nickel
Petroleum and Natural Gas
Phosphate Rock
Platinum
Potash
Precious Stones
Quicksilver
Radium
Selenium and Tellurium
Sodium Salts
Sulphur, Pyrite and Sulphuric Acid
Talc and Soapstone
Tin
Titanium and Zirconium
Tungsten
Uranium and Vanadium
Zinc
Ore Dressing and Coal Washing
Mineral Statistics

Send only this coupon but send it now

These chapters are the work of specialists of recognized standing in each particular industry.

The book is a priceless reference book for metallurgists, mining engineers, chemists, and exporters and importers—for any man who produces, purchases or sells minerals.

Whatever you want to know about production, consumption, imports, exports, uses, grades of minerals, new developments in technology and sources of supply—MINERAL INDUSTRY has it for you.

EXAMINE IT FREE

Get a copy of MINERAL INDUSTRY to examine for ten days without charge. See for yourself how thorough it is—how helpful—and then keep it or send it back as you see fit. Send the coupon only.

Free Examination Coupon

McGraw-Hill Book Co., Inc., 370 Seventh Avenue, New York.

You may send me on 10 days' approval **Mineral Industry, Vol. XXXI, $12.00 net, postpaid.**

I agree to pay for the book or return it postpaid within 10 days of receipt.

.....I am a regular subscriber to Eng. & Min. J.-P.

Signed .....

Address .....

Official Position .....

Name of Company .....

(Books sent on approval to retail purchasers in U. S. and Canada only.)

J. 12-29-23

"American" Lap-welded Pipe

For the Hardest Kind of Usage

In connection with very high pressure hydraulic work, hydro-electric installations, large condenser and vacuum piping, rotary dryers and roasters, etc., "American" Lap-welded Pipe is particularly well adapted.

It is made from the best quality of refined, open hearth, special welding steel, having a tensile strength of from 48,000 to 58,000 pounds per square inch.

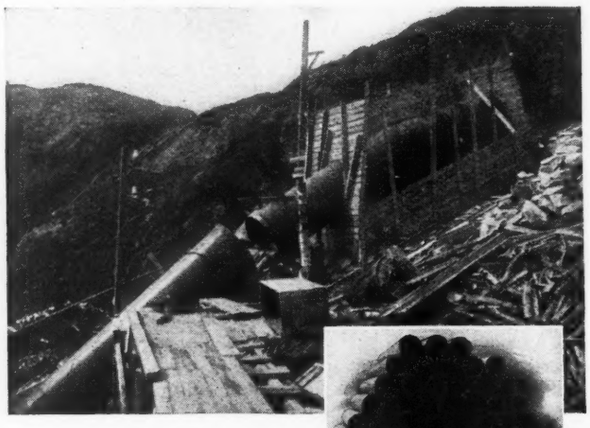
Our process of forge welding gives a uniform and reliable weld. After welding, the pipe is thoroughly annealed and all strains removed.

"American" Lap-welded Pipe is a quality product, in the truest sense. It is a precision pipe for the most exacting requirements.

All flanges are of forged steel made from the best quality of open hearth steel—There are no cast-iron flanges with the accompanying breakage in American Spiral Pipe lines.

This is the pipe which the Calumet & Hecla Mining Co. chose for the dredge-work at Lake Linden, Mich.

Put your pipe problems up to our engineers. They are at your service.



The photograph above shows a Hydro-Electric installation of "American" Lap-welded Pipe at Hoyanger-Sogn, Norway. It contains a working pressure of 378 pounds and is 44½ in. in diameter.

Below is shown a nesting of pipe for export shipment. When an installation is in the mountains we often limit the weight of any one package to 300 pounds and the pipe lengths to from 6 to 12 feet.

American Spiral Pipe Works
Main Office and Works
P. O. Box 485, Chicago, Ill.
New York Office: 50 Church St., New York City

LITTLE GIANT
POWER HAMMERS

Made in Four Types, Five Sizes
BELT OR MOTOR DRIVEN

25, 50, 100, 250 and 500 lb. models. Adapted for all kinds of forge work.

OVER 1000
IN USE IN MINES

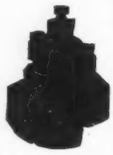
Guaranteed FOREVER against defect and sold on 30 days' free trial.

Write for full information

LITTLE GIANT CO.
250 Rock St., Mankato, Minn.

This is the small belt-driven type

POWELL VALVES
The Wm. Powell Co. Cincinnati, Ohio



MERCO NORDSTROM PLUG VALVE
MERRILLITE
Send for Bulletins
THE MERRILL COMPANY

SAN FRANCISCO	NEW YORK
121 Second St.	110 West 40th St.
HOUSTON	CHICAGO
613 Washington Ave.	1631 Monadnock Block

"WAINWRIGHT" EXPANSION JOINTS
High and Low Pressure Designs
Alberger Pump & Condenser Co.
140 Cedar St., New York City
Philadelphia Chicago
Boston St. Louis

THERMOLITH
FIRE CEMENT
"Makes the Weakest Point the Strongest"
HARBISON-WALKER REFRACTORIES CO.
World's Largest Producers of Refractories
Pittsburgh, Pa. *U.S.A.*

"CRANDALLIZE AND ECONOMIZE"

CRANDALL PACKING COMPANY
PALMYRA, N. Y.

Skinned Knuckles, Bruised Fingers and Profanity

cannot be avoided when the old-fashioned open-end wrench is used.
Why not avoid trouble and save time by turning nuts with the

FAVORITE reversible ratchet WRENCH

Its socket form of head cannot slip off the nut and its quick ratchet movement turns the nut like lightning. None of the quarter turn and a fresh hold of the old-fashioned wrench. Once on the nut the Favorite stays there until it is seated or removed.

The Favorite Wrench does away with the lost motion of nut turning.

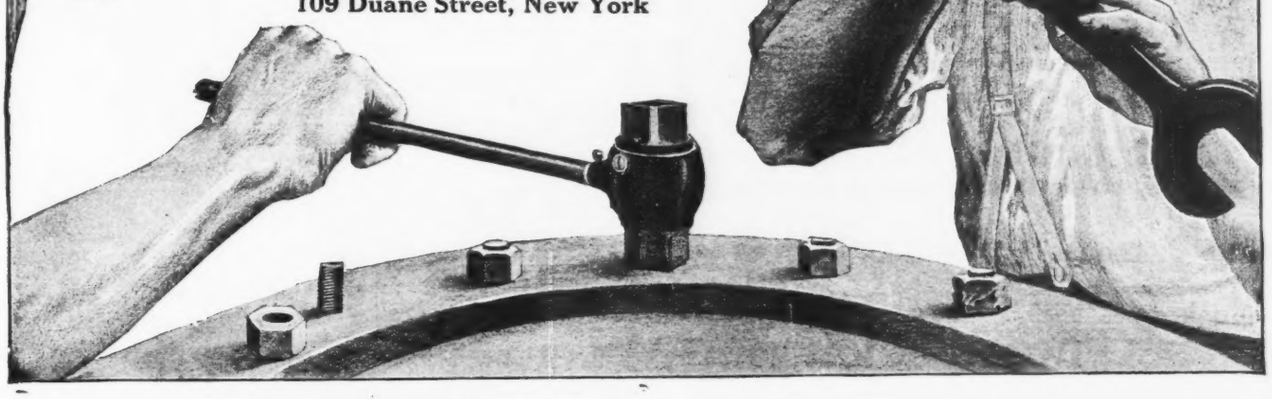
Why plug away with the old-fashioned wrench?

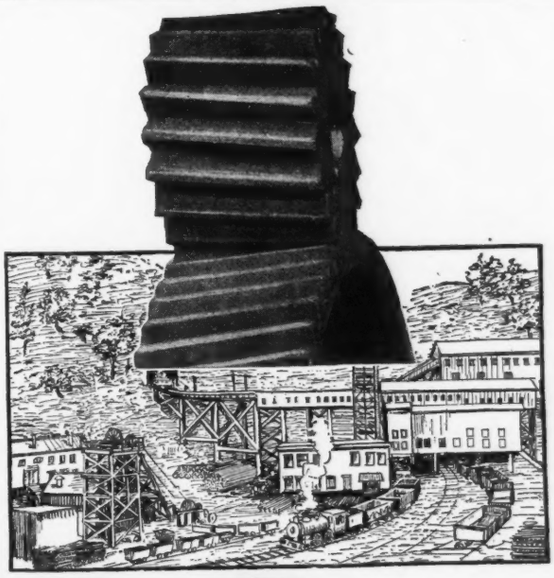
Built strong to stand rough usage

GREENE, TWEED & CO.

Sole Manufacturers

109 Duane Street, New York





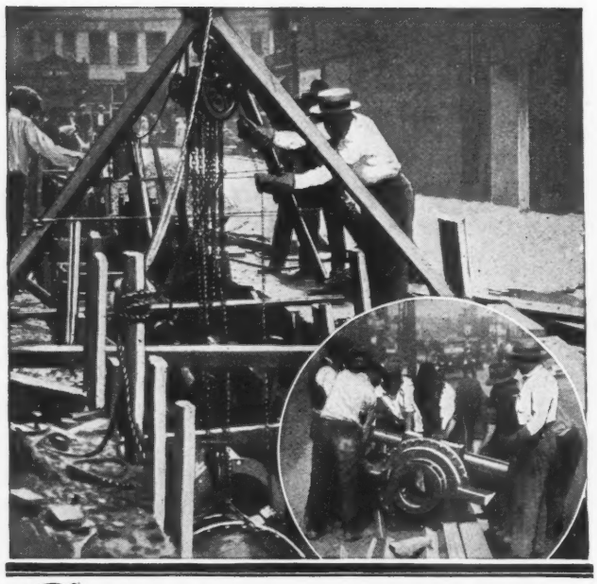
One shutdown to replace a broken or wornout gear—one stoppage of your production and output—what will it cost you?

Nuttall BP Gears are guaranteed to last four times as long as ordinary gears. That means a saving you cannot afford to overlook.

R.D. NUTTALL COMPANY
PITTSBURGH PENNSYLVANIA

All Westinghouse Electric & Mfg. Co. District Offices are Sales Representatives in the United States for the Nuttall Electric Railway and Mine Haulage Products. In Canada: Lyman Tube & Supply Co., Ltd., Montreal and Toronto.

Nuttall



CYCLONE HOISTS
HIGH SPEED

We Saw this Example of Labor Saving From Our Office Window!

IT took nine husky men, with many a "yo" and a heave, to place this ponderous fitting in position for lowering into a trench dug by the Cleveland Electric Illuminating Co. for laying the steam pipes to the new Union Trust Building, Cleveland.

When hooked to the Cyclone Hoist, rigged over the trench, one man alone lowered the same heavy weight into position!

One never need go far to find places where a Cyclone Hoist can save labor and cut costs. Perhaps *you* need only look out *your* window into your factory yard, your shop or warehouse to see instances where a Cyclone Hoist can profitably replace muscle-methods. Look!

Send for catalog covering 1 to 40 Ton Hoists Cranes, Trolleys and Overhead Track Systems.

DISTRIBUTORS EVERYWHERE

The Chisholm-Moore Mfg. Co.
Cleveland, O.
Hoists Cranes Trolleys
Overhead Track Systems
Branches: **New York, Chicago, Pittsburgh**

Standardize

Fig. 1021 "Ferrenewo" Iron Body Globe Valve

Fig. 73 "Renewo" Bronze Globe Valve

LUNKENHEIMER
"Ferrenewo and Renewo" Valves

The Iron Body "Ferrenewo" for low pressures and the Bronze "Renewo" for high pressures enables standardization of these Valves throughout the plant with ECONOMY and SERVICE assured—economy, in that maintenance of upkeep is reduced to the minimum, and prolonged satisfactory service, because of proved correct design, high grade materials and workmanship.

The seating surfaces and all parts, including the nickel seat and disc, are renewable.

Write for a copy of Catalog 58-BK

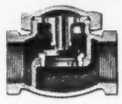


Fig. 863 "Renewo" Bronze Horizontal Check Valve

Fig. 898 "Ferrenewo" Iron Body Horizontal Check Valve

102-26-20

THE LUNKENHEIMER CO.
"QUALITY"
LARGEST MANUFACTURERS OF HIGH GRADE ENGINEERING SPECIALTIES IN THE WORLD
NEW YORK CHICAGO CINCINNATI U.S.A. BOSTON LONDON
EXPORT DEPT. 125-135 LAFAYETTE ST. NEW YORK

"America's Best since 1862"

MAAG GEARS

Strongest at the base
Where strength is most needed

NILES-BEMENT-POND CO.
111 Broadway, New York City

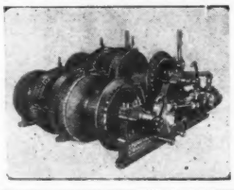
HERRINGBONE CUT GEARS

MILL DRIVES
SPEED REDUCERS

FAWCUS

SPUR
WORM
BEVEL GEARS

FAWCUS MACHINE CO. PITTSBURGH, PA.



Flory Hoists
For every requirement
Steam—Electric—Gasoline
S. Flory Mfg. Co.
Bangor, Pa.
95 Liberty St., New York.

Only reliable products can be continuously advertised

Why Grope in the Dark?

Dirt cannot lodge in the burner of this lamp.

A small wire, as shown, ejects any dirt from the burner *without interfering with the light,* and without the lamp being removed from the operator's cap.

RECENT IMPROVEMENTS:

Much heavier wires now used, cannot break or bend.
New improved felt holders.

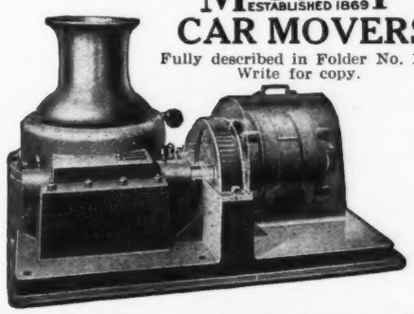
THE GRIER BROTHERS CO.
1411-17 Brighton Road, Pittsburgh, Pa.
Western Branch, Hancock, Mich.

CARBIDE TP TROUBLE-PROOF **LAMPS**

DEWAR MANUFACTURING CO.
26-32 THIRTY-FIFTH STREET
BROOKLYN, N. Y.

FALK
HERRINGBONE GEARS
Precision-made speed reduction units
—any size—for any job.
THE FALK CORPORATION
Milwaukee, Wisconsin

TRADE MARK
MUNDY
ESTABLISHED 1869
CAR MOVERS
Fully described in Folder No. 11.
Write for copy.



J. S. MUNDY HOISTING ENGINE CO.
Newark, New Jersey, U. S. A.

The Acme *Steel Lamp*

THE Acme is a simple, light weight, Rust-Proof—Heavily Tinned steel lamp, ruggedly built for the toughest kind of service.

It gives a steady, reliable, brilliant light, burns a full half shift without recharging and is absolutely safe. A money saver because it increases production.

Acme Steel Lamps are standard equipment in the leading metal mines all over the world. *Write for Catalog No.* 4.

JUSTRITE MFG. CO.
2080 Southport Ave., Chicago, Ill.

United States Metals Refining Co.

New York Office: 61 Broadway

Smelter and Refinery at
CARTERET, NEW JERSEY

Buyers of:

Ores, Mattes, Concentrates, Residues containing, Copper, and or Silver, and or Gold, Copper Bullion, Black Copper, Copper and Brass Furnace Materials

Producers of:

Electrolytic Copper, "DRW" Brand Silver, Gold, Platinum, Palladium, Selenium

The American Metal Co., Ltd.

61 Broadway, New York — Oliver Bldg., Pittsburgh, Pa.

Boatman's Bank Bldg. ST. LOUIS — A. C. Foster Bldg. DENVER

Buyers of

Gold, Silver, Lead, Zinc and Copper Ores.
Copper Matte, Copper Bullion and Lead Bullion.
Molybdenum and Tungsten Concentrates.

Producers of

Gold, Silver, Copper Lead and Zinc.

Importers of

Tin

THE GRASSELLI CHEMICAL CO.

Producers of

ZINC
ZINC DUST
SHERARDIZING ZINC

Buyers of

ZINC ORES
ZINC CONCENTRATES

Guardian Building, CLEVELAND, OHIO — 347 Madison Avenue, NEW YORK, N. Y.

NICKEL

—shot, ingot, electrolytic 99.8%, malleable nickel in all commercial forms.

MONEL METAL

—castings, shot, ingot, rod, sheet, tubes, etc.

THE INTERNATIONAL NICKEL CO.
67 WALL ST., NEW YORK

AUSTIN GYRATORY CRUSHERS

Portable and Stationary Plants
Capacities, 5 to 300 tons per hour

AUSTIN MANUFACTURING CO.
New York — CHICAGO — San Francisco

PHELPS DODGE CORPORATION

99 JOHN STREET, NEW YORK

"C★Q" ELECTROLYTIC **COPPER** "P.D.Co." CASTING

Jigs, Screens, Sand and Slime Tables, Classifiers, Automatic Ore Feeders Etc.

Manufactured by
JAMES ORE CONCENTRATOR CO.
35 Runyon Street, Newark, N. J.

Rosiclare Fluor Spar *All Grades*

ROGERS, BROWN & Co.

SALES AGENTS

CINCINNATI, NEW YORK, CLEVELAND, CHICAGO, BUFFALO, ST. LOUIS, BOSTON, PITTSBURGH, PHILADELPHIA

NICHOLS COPPER CO.

(Established in 1872 as G. H. Nichols & Co.)

Makers of

LNS Brand Electrolytic Copper
Triangle Brand Copper Sulphate
99% pure

Buyers of

Copper Ores, Mattes and Blister

■

Sales Office: 25 Broad St. | Cable Address "Triangle" | Refinery: Laurel Hill

NEW YORK

■

FOREIGN REPRESENTATIVES

Société des Minerais et Métaux
88 Rue de Courcelles
Paris, France

Société Génerale des Minerais
3 Rue de Marais
Brussels, Belgium

United Metals Selling Company

25 Broadway
New York

Pig Lead—
Desilverized Common and Corroding
International I. L. R. Co.

Electrolytic Zinc
Highest Grade and Purity
Anaconda Electric

Selenium, Arsenic, Nickel Salts,
Tellerium, Cadmium
Copper Sulphate

ASSAYERS & REFINERS

Specialists in

Palladium PLATINUM Iridium
Rhodium Ruthenium Osmium
Gold and Silver

PLATINUM SCRAP PURCHASED

BAKER & CO., INC.

Refiners and Workers of Platinum Gold and Silver

10 Church St., New York | 54 Austin St. NEWARK, N. J. | 5 S. Wabash Ave., Chicago

International Smelting Company

25 Broadway, New York

Purchasers of
Gold, Silver, Copper
and Lead Ores

Smelting Works
International, Utah Miami, Arizona

Ore Purchasing Department
618 Kearns Building, Salt Lake City, Utah

Refineries
Raritan Copper Works, Perth Amboy, N. J.
International Lead Refining Co., East Chicago, Ind.

Matthiessen & Hegeler Zinc Co.

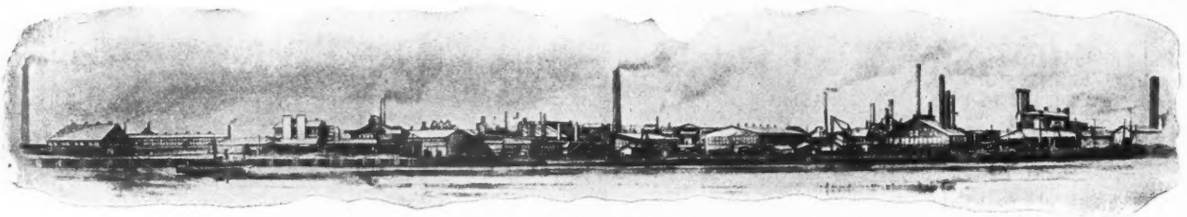
La Salle, Ill.

Manufacturers of

SHEET ZINC
(Corrugated and Plain)
RIBBON ZINC, in Coils
SLAB ZINC
SULPHURIC ACID

Sheet Zinc for use in the Cyanide Process, perforated so as to meet the requirements of the Mexican Customs Laws.

Eastern Offices:
111 Broadway, New York City Telephone Rector 5595



Buyers of
Ores—Concentrates—Lead Bullion—Dore Bullion—Residues
Containing
Gold—Silver—Platinum—Copper—Lead
BALBACH SMELTING AND REFINING COMPANY
Works: Newark, N. J. *Established 1852* Offices: Newark, N. J.—280 Broadway, N. Y.
BALBACH METALS CORPORATION
Established 1922
280 Broadway, New York

Bartlesville Zinc Co.
Bartlesville, Okla.

ZINC

Blackwell Zinc Co.
Blackwell, Okla.

Prime Western and Brass Special
Also Zinc Oxide and Zinc Dust

Sole Agents:
THE AMERICAN METAL COMPANY, LIMITED
61 Broadway, New York

AMERICAN ZINC, LEAD & SMELTING CO.
PURCHASERS OF
ZINC AND LEAD ORES
ADDRESS 1012 PIERCE BLDG. ST LOUIS, MO.
EXPLORATION DEP'T. FOR THE PURCHASE OF
METAL MINES & METAL MINING COMPANIES
55 CONGRESS ST. BOSTON, MASS.

ILLINOIS ZINC CO.
PERU, ILLINOIS
Manufactures of
SELECTED BRASS, SLAB ZINC
and SULPHURIC ACID
Rollers of SHEETS, PLATES and STRIPS
ZINC in special sizes, squares and circles, cut to order. Etchers,' Engravers', Lithographers' and Battery Plates. Paper and Card Makers' Sheets.
EASTERN SALES OFFICE
Tel. Worth 1496 280 Broadway, New York

Irvington Smelting & Refining Works
Formerly Glorieux Smelting & Refining Works
Buyers, Smelters and Refiners of
Gold, Silver, Lead, Copper and Platinum Ores, Sweeps and Bullion
Manufacturers of Copper Sulphate
Irvington, New Jersey
Lehigh Valley R. R. connection
New York Office:
CHARLES ENGLEHARD, Hudson Term. Bldg., 30 Church St.

ORES—METALS—MINERALS
FERRO-ALLOYS
ALLUMINUM
SHEETS and INGOTS

Molybdenum		Manganese
Tungsten		Vanadium
Bismuth		Chrome
Copper	Antimony	Zinc
Lead	Nickle	Tin

GOLD—SILVER—PLATINUM
Charles Hardy & Ruperti, Inc.
115 Broad St., New York City

American Smelting & Refining Co.

Buyers of

All non-ferrous Bullion, Ores, Concentrates, Mattes and Blister

Producers and Sellers of

GOLD	ZINC	ARSENIC
SILVER	ZINC DUST	CADMIUM
COPPER	ZINC OXIDE	CADMIUM SULPHIDE
LEAD	(Columbine Brand)	SELENIUM
TEST LEAD	NICKEL SALTS	TELLURIUM
C. P. LITHARGE	BISMUTH	THALLIUM

SALES OFFICE: 120 BROADWAY, NEW YORK

Manufacturers of

SELBY LEAD PRODUCTS

Address inquiries to

American Smelting & Refining Co.
444 California St., San Francisco, Cal.

SHEET *and* ROLL COPPER

Address inquiries to

Baltimore Copper Smelting & Rolling Co.
Baltimore, Md.

United States Smelting
Refining & Mining Company

55 Congress Street, Boston, U. S. A

Buyers of

Gold, Silver, Lead and Copper Ores; Lead and Zinc Concentrating Ores; Matte and Furnace Products.

Refiners of Lead Bullion

Producers and Sellers of

Gold, Silver, Lead, Copper, Cadmium, Arsenic, Copper Carbonate, Sodium Arsenite and Tellurium.

OPERATING OFFICES:

912 Newhouse Building, Salt Lake City, Utah; Kennett, Cal.; Goldroad, Arizona; Eureka, Colorado (Sunnyside Mining & Milling Co.); Baxter Springs, Kansas; Pachuca, Mexico (Real del Monte Co.).

Selling Offices: 120 Broadway, New York

United States Smelting R. and M. Exploration Company
For examination and purchase of Metal Mines, 55 Congress St., Boston, Mass. District Offices, 120 Broadway, N. Y. 1504 Hobart Building, San Francisco, Cal. Newhouse Building, Salt Lake City, Utah

ABRAHAMSON, Hjalmar
518-28 U. S. Nat'l Bank Bldg., Denver, Colo.
No professional work undertaken

ADAMS, Huntington
MINING ENGINEER
522 Fifth Avenue
New York City

ADAMSON, W. G.
MINING ENGINEER AND METALLURGIST
Winnemucca, Nev.

ADDICKS, Lawrence
CONSULTING ENGINEER
51 Maiden Lane, New York City
Cable: Galie, New York

AGUILAR-REVOREDO, J. F.
GENERAL MANAGER
La Cotabambas Auraria
(Cotabambas Gold Co.)
Cuzco, Peru, So. Amer.

ALDRIDGE, Walter H.
MINING AND METALLURGICAL ENGINEER
41 East 42nd St., New York

ALLIED ENGINEERS, Ltd.
A. K. Knickerbocker, H. I. Pearl, E. B. Cullity
MINING ENGINEERS AND GEOLOGISTS
Examinations, Exploration and Mine Management
Crosby, Minn. The Pas, Man.

AMBRUSTER, H. W., Consultant
ARSENIC AND CALCIUM ARSENATE
Preliminary surveys based on world and local conditions prepared for financial interests contemplating engaging in this industry. Complete advice furnished on all phases from raw materials to finished products. Reports on Arsenic and Insecticide markets compiled, estimates and plans for complete plants prepared, equipment designed, built and installed, manufacturing processes and operation supervised and sale and distribution organized.
261 Broadway, New York

ANDERSON, A. P.
CONSULTING MINING ENGINEER
U. S. Smelting, Refining & Mining Company
1504 Hobart Bldg., San Francisco, Cal.

ANDERSON, G. E.
Engineering Co.
GEOLOGISTS
Petroleum, Metals
206 Anchor Bldg., Fort Worth, Texas

ANDREWS, Worth B.
MINING ENGINEER
Texas National Bank Bldg., Fort Worth, Texas
Code: Bedford-McNeill

B. C. Austin G. E. Gamble W. V. Wilson
AUSTIN, WILSON & GAMBLE
MINING ENGINEERS
316 Kohl Bldg., San Francisco
Cable: Austin Usual Codes

AYRES, W. S.
MINING AND MECHANICAL ENGINEERING
Consultation, Examination, Reports. Long Experience as Manager of Iron and Coal Mines,
Hazleton, Pa.

BABB, Percy Andrus
MINING AND METALLURGICAL ENGINEER
Apart. No. 92, Pachuca, Hgo., Mexico

BALL, C. Leonard
MANAGING DIRECTOR
Compania Huanchaca de Bolivia
Cable Address: Lenball, Valparaiso, Chile

BALL, Sydney H.
MINING GEOLOGIST
42 Broadway, New York
Cable: Alhasters Rogers, Mayer & Ball

BANCROFT, Howland
MINING GEOLOGIST AND ENGINEER
737 Jackson St., Denver, Colorado
Cable: Howban, Denver Code: Bedford-McNeill

BANKS, Charles A.
MINING ENGINEER
612 Pacific Bldg., Hastings St. W.,
Vancouver, B. C.
Cable: Bankca Code: Bedford McNeill

BANKS & SON, John H.
MINING ENGINEERS AND METALLURGISTS
26 John St., New York
Cable: "Metbanks"

BARRY, John G.
MINING GEOLOGIST AND ENGINEER
Explorations, Examinations, Development, Geol. and Top. Maps, Sections: Mexico specialty.
Mills Building, El Paso, Texas, c/o A. S. & R. Co.

BEATTY, A. Chester
CONSULTING MINING ENGINEER
25 Broad St., New York
No professional work entertained
Cable: Granfie

Hamilton, Beauchamp, Woodworth, Inc.
BEAUCHAMP, F. A.
METALLURGIST
Specialty: Flotation
Chancery Bldg., 564 Market St., San Francisco

BEAUDETTE, A. J.
MINING ENGINEER
Istmina, Republic of Colombia, South America

BEDFORD, Robert H.
MINING ENGINEER
Grass Valley, California

BELL, Charles N.
CONSULTING MINING ENGINEER
The Metals Exploration Co., 201 Fourteenth St.,
Denver, Colorado

W. F. B. Berger Robert H. Sayre
BERGER & SAYRE
MINING ENGINEERS
617 Majestic Bldg., Denver, Colorado

BJORGE, Guy N.
MINING GEOLOGIST
788 Mills Bldg., San Francisco, Calif.

BOISE, Charles W.
MINING ENGINEER
Foreign Exploration
Room 1507, 14 Wall St., New York
Cable: Mukeba

BOTSFORD, C. W.
CONSULTING MINING ENGINEER AND GEOLOGIST
Inspiration, Arizona

BOTSFORD, R. S.
MINING ENGINEER
321 Hillside Ave., Jamaica, L. I., U. S. A.
2 Drapers Gardens, London, England

BOWMAN, Frank A.
MINING ENGINEER
Bellflower, California

BRADT, Harlan H.
MINING GEOLOGIST AND ENGINEER
120 Broadway, New York City

BROCKUNIER, Sam Hugh
MINING ENGINEER
PETROLEUM GEOLOGIST
6624 Dalzell Place, Pittsburgh, Pa.

BRODIE, Walter M.
MINING AND METALLURGICAL ENGINEER
1807 Phelps Place, Washington, D. C.

BROWN, R. Gilman
CONSULTING ENGINEER
Pinners Hall, London, E. C. 2
Cable: Argeby Usual Codes

BROWNE, Spencer C.
MINING ENGINEER
2 Rector Street, New York
Cable: Spenbrowne, New York

BURCH, HERSHEY & WHITE
Albert Burch, O. H. Hershey, Lloyd C. White,
CONSULTING MINING ENGINEERS
Crocker Bldg., San Francisco, Cal.
Cable Address: "Burch" San Francisco Usual Codes

BURCH, H. Kenyon
CONSULTING ENGINEER
806 Jr. Orpheum Bldg., Los Angeles, Cal.

BURDICK, Charles A.
MINING AND METALLURGICAL ENGINEER
Equitable Bldg., 120 Broadway, New York
Phone: Rector 1645

BURNS, William
MINING ENGINEER
788 Mills Bldg., San Francisco, Calif.

BURRALL, Frederick P.
MINING ENGINEER
Longyear Bldg., Marquette, Michigan

CALKINS, F. E.
MINING GEOLOGIST AND ENGINEER
Globe, Arizona

CALLOW, J. M.
Pres. General Engineering Co.
CONSULTING METALLURGICAL ENGRS.
Room 1242, 50 Broad St., New York
159 Pierpont St., Salt Lake City, Utah, U. S. A.

CARPENTER, Alvin B.
MINING ENGINEER
6735 Yucca St., Hollywood, Cal.

CATTELL, Owen
MOTION PICTURES of mines, properties, constructions, etc., produced anywhere.
3939 Grand Central Terminal, New York City

CHANCE & Co., H. M.
COAL MINING ENGINEERS IRON
839 Drexel Bldg., Philadelphia

CHANNING, J. Parke
CONSULTING ENGINEER
61 Broadway, New York

CHASE, Charles A.
MINING ENGINEER
825-826 Cooper Bldg., Denver
Liberty Bell G. M. Co., Telluride, Colo.

CHASE, E. E. and R. L.
MINING AND GEOLOGICAL ENGINEERS
207 Colorado Nat. Bk. Bldg.
Denver, Colo.

CHÈDÉ, L.
INGENIEUR DES MINES
Long experience Colombian properties, Examinations, Reports, Purchases. Cali, Republic of Colombia

CLAPP, Frederick G.
CONSULTING GEOLOGIST
30 Church St., New York City

CLAUSEN, Carl
ENGINEER
Bisbee, Arizona. Design and erection of mills for concentration, amalgamation, cyaniding, etc. Smelters and Power Plants

CLEMENTS, J. Morgan
MINING GEOLOGIST
20 Broad St., New York
Code: Bedford-McNeill Telephone: Rector 1575

COHEN, Samuel W.
CONSULTING MINING ENGINEER
Dominion Express Bldg., Montreal, Canada

COLBATH, Jas. S. MINING ENGINEER
Specializing in the Applications of the Cyanide Process. Equipment and Operation of Mines
3501 Tularosa St., El Paso, Texas

COLE, F. L.
MINING ENGINEER
98 Bulvarny Prospect
Harbin, Manchuria, China
Cable: Amrustraco

COLLBRAN, Arthur H.
MINING ENGINEER
Seoul, Korea

COLLINS, George E.
MINING ENGINEER
Mine Examinations and Management
307 Boston Bldg., Denver
Cable: Colomac

COLLINS, W. F.
CONSULTING MINING & METALLURGICAL ENGINEER
Cable: Collins, Peking Peking, China

COPELAND, Durward
METALLURGICAL ENGINEER
Casilla 53, Oruro, Bolivia, South America

CONSTANT CO., C. L.
MINING, METALLURGICAL AND CHEMICAL ENGINEERS
New York Office, 220 Broadway, New York, N. Y.
Cuban Office, Amargura 23, Havana, under J. C. Porter. Registered Mining Engineer under Cuban law.

CRANSTON, Robert E.
MINING ENGINEER
1213 Hobart Bldg., 582 Market St.
San Francisco 2 Rector St., New York
Cable: Recrans Code: McNeill 1908

DAHL, S. K.
MECHANICAL AND MILLING ENGINEER
Testing Ores, Designing and Building Mine Plants and Mills.
Central Bldg., Los Angeles, Cal.

DARLING, Harry W.
MINING ENGINEER
Box 489, Timmins, Porcupine District
Ontario, Canada

DEFTY, W. E.
MINING ENGINEER
Phoenix, Arizona
618 North Third Avenue

DEMMING, Henry C.
MINING ENGINEER, GEOLOGIST, MINERALOGIST AND CHEMIST
Offices and Laboratory
1152 Mulberry St., Harrisburg, Penn.

DENNIS, Clifford G.
MINING ENGINEER
Crocker Bldg., San Francisco
Cable: Sinned Code: McNeill

DICKERMAN, Nelson
MINING ENGINEER
The Insurance Exchange, San Francisco
Cable: Deerhodor Code: McNeill 1908

DORR, John V. N.
President, The Dorr Co., Metallurgical and Chemical Engineers. Investigations, Plant Design
247 Park Ave., New York

DRAPER, MARSHALL D.
MINING ENGINEER
Mongtze, Yunnan, China
U. S. Address: 213 Boston Bldg., Denver, Colo.
Code: Bentley

DREW, C. V.
MINING ENGINEER
With Cerro de Pasca Copper Corporation, Room 4, Fifth floor, 15 Broad St., New York

DUDLEY, H. C.
MINING ENGINEER
704 Lonsdale Bldg., Duluth, Minn.

DUNCAN & LINDLEY
MECHANICAL ENGINEERS
for Mines and Mills. 649 Mills Bldg., San Francisco, Cal.

DWIGHT, Arthur S.
MINING ENGINEER AND METALLURGIST
29 Broadway, New York
Cable: Sinterer Code: McNeill; Miners & Smelters

EASLEY, George A.
MINING ENGINEER
La Paz, Bolivia, South America
Cable: Address: "Easley," La Paz

EASTON, Stanly A.
MINING ENGINEER
Manager, Bunker Hill & Sullivan Mining and Concentrating Co., Kellogg, Idaho

EDE, J. A.
CONSULTING MINING ENGINEER
La Salle, Illinois

ELLIOTT, Roy H.
MINING ENGINEER
Room 1200, First National Bank Bldg., San Francisco
Cable: Rhell Usual Codes

Wm. W. Elmer Geo. C. Hogg
ELMER & HOGG
CONSULTING MINING ENGINEERS
Examinations, Reports, Administration
U. S. Nat. Bank Bldg., Portland, Oregon

EMERY, A. B.
MINING ENGINEER
Messina, Transvaal. Tele. and Cable Address: Abemery, Messina, Transvaal

EMLAW, H. S.
MINING ENGINEER
233 Broadway, New York City

ERDLETS, Jr., Joseph F. B.
MINING ENGINEER
61 Broadway, New York
Cable Address: Branderlet, New York

EXPLORATION COMPANY OF MEXICO
Examination and Management of Mines
Chief Engineer Mail Address
I. M. Hirschfield Apartado 2467 Mexico City

EYE, Clyde M.
MINING AND METALLURGICAL ENGINEER
1006 Hobart Bldg., San Francisco, Cal.
Cable: Eyecon Code: Western Union

FARISH, George E.
CONSULTING MINING ENGINEER
25 Broad St., New York

FARISH, John B.
MINING ENGINEER
No professional work accepted
Address: Stanford Court, San Francisco, Cal.
Cable: Farish

FERRIER, W. F.
CONSULTING MINING ENGINEER AND GEOLOGIST
52 St. Andrew's Gardens, Toronto, Canada

FESING, Herman W.
MINING ENGINEER
Lake Superior Copper and Iron Examinations, Houghton, Mich.

FINCH, John Wellington
MINING GEOLOGIST AND ENGINEER
14 Wall St., New York. Telephone: Rector 8754

FINLAY, J. R.
MINING ENGINEER
Room 1410, 170 Broadway, New York

FITCH COMPANY, Walter Jr.
SHAFT AND TUNNEL CONTRACTORS
Eureka, Utah

FISHER & LOWRIE
CONSULTING GEOLS. AND FUEL ENGRS.
1st. National Bank Bldg., Denver
1409, 170 Broadway, New York
Cable: Califshoil Usual Codes

FLAGG, Arthur Leonard
CONSULTING ENGINEER
306 Goodrich Bldg., Phoenix, Arizona

FOHS, F. Julius OIL GEOLOGIST
Kirby Bldg. 1st Nat'l Bank Bldg.
Dallas, Texas Tulsa, Oklahoma
60 Broadway, New York
No professional work undertaken

FORBES, David L. H.
MINING ENGINEER
Kirkland Lake, Ontario

FOWLER, Samuel S.
MINING ENGINEER AND METALLURGIST
Nelson, British Columbia
Cable: Fowler Usual Codes

FRANCE, T. H.
MINING ENGINEER
42 Broadway, New York City

FRANK, ALFRED
MINING ENGINEER
1121 Newhouse Bldg., Salt Lake City, Utah

FULLER, John T.
MINING ENGINEER
American Bauxite Co., Bauxite, Ark. Permanent address. 1306 Main St., Honesdale, Pa.

GAHL, Rudolf
CONSULTING METALLURGIST
Specializes in Concentration, Flotation and Leaching of Copper Ores
1101 Laurel St., Berkeley, Calif.

GARREY, George H.
CONSULTING MINING GEOLOGIST AND ENGINEER
Appraisal of possibilities outlining development work, geologic mine maps
Bullitt Bldg., Philadelphia, Pa.
Code: Bedford-McNeill

GARZA, Aldape, J.M., E.M., M.E.
CONSULTING GEOLOGIST AND MINING ENGINEER
Examination and Management of Properties
P. O. Box 229, Torreon, Coahuila, Mexico

GIBSON, Arthur
MINING ENGINEER
Placer Mining and Magnetometric Determinations of Mineral Concentrations in the field.
300 Haight St., San Francisco, Cal.

GIANELLA, Vincent P.
MINING ENGINEER
429 Marsh Avenue, Reno, Nevada

GRAHAM, Stanley N.
MINING ENGINEER
Mining and Metallurgical Dept., Queens University
Kingston, Ont., Canada

GRANT, Wilbur H.
GEOLOGICAL AND MINING ENGINEER
1213 Hobart Bldg., 582 Market St.
San Francisco
Code: Bedford McNeill

Grondijs, H. F. Sohnlein, M. G. F.
GRONDIJS & SÖHNLEIN
CONSULTING MINING ENGINEERS
Specialty: Mining and Milling of Bolivian Tin Ores. Completely equipped metallurgical plant for testing ores in any quantity up to 10 tons.
Office: Compania 1264
Ore Testing Works: Avenida Manuel Montt 1561, Santiago, Chile. Cables: Grondysohn.

GRUGAN, Justice F.
MINING ENGINEER
135 Broadway, New York
Cable Address: Jusgrugan, New York

GUESS, H. A.
MINING ENGINEER
120 Broadway, New York City

HALL, R. G.
CHEMICAL AND METALLURGICAL ENGR.
Complex Ores, Electrolysis
835 Hyde St., San Francisco, Cal.

HALLORAN, Will
MINING ENGINEER
Kingman, Arizona

HAMILTON, E. M.
METALLURGIST
Specialty: Cyaniding Gold and Silver Ores
Chancery Bldg., 564 Market St., San Francisco

HAMILTON, Fletcher
CONSULTING ENGINEER, MINING AND PETROLEUM
State Mineralogist of California, 1913-1923
Hobart Bldg., San Francisco

HAMILTON, Orr R.,
CONSULTING MINING ENGINEER
No tax work solicited
Cosmos Club, Washington, D. C.

HAMMOND, John Hays
CONSULTING ENGINEER
120 Broadway, New York
Code: Bedford-McNeill

HARDY, J. Gordon
MINING ENGINEER
Room 1505, 60 Broadway, New York City

HARRIS, Joseph W.
Chemical, Metallurgical and Mining Patents
Washington Loan & Trust Bldg., Washington, D. C.

HEINZ, N. L.
ENGINEER
Design and erection of zinc and Sulphuric Acid plants and parts thereof
River Forest, Illinois

HENDERSON, H. P.
MINING ENGINEER
522 Fifth Ave., New York

HERSEY Co., Milton, Ltd.
MINING ENGINEERS
Consultation, Examination and Management
84 St. Antoine St., Montreal, Can.
"Milhersey"—Bedford-McNeill Code

HERSHEY, Oscar H.
CONSULTING MINING GEOLOGIST
19 Fordonia Bldg., Reno, Nevada
Cable: Hershey Code: McNeill

HESS, Rush M.
MINING ENGINEER
Examination, Consultation, Supervision. 807 Brown-Marx Bldg., Birmingham, Ala.
Cable: "Rumihe. Code: Bedford-McNeill"

K. F. HESS and C. A. METTE
CONSULTING ENGINEERS
Mining, Metallurgy, Petroleum, Plant Design, Construction, Operation
709 Grosse Bldg., Los Angees, Calif.

HILLS, Victor G.
MINING ENGINEER
312 17th St., Denver, Colo.

HOFFMAN, John D.
MINING ENGINEER
1 London W 1 Buildings, London, E.C.2
Usual Codes

HOFFMAN, Karl F.
MINING ENGINEER
Cable: Manhoff 2 Rector St., New York

HOFFMAN, Ross B.
MINING ENGINEER
228 Perry St., Oakland, Cal.
Cable: Siberhof

HOLDEN, Edwin C.
CONSULTING MINING ENGINEER
1100 Garrett Bldg., Baltimore, Md. Code: Bedford-McNeill. Cable: "Nedloh," Baltimore

HOLLAND, L. F. S.
MINING ENGINEER
1718 La Brea Avenue, Hollywood, Cal.

HOLLIS, H. L.
CONSULTING MINING ENGINEER AND METALLURGIST
435 Railway Exchange, 80 E. Jackson Blvd., Chicago

HOSKIN, Arthur J.
CONSULTING ENGINEER
214 Transporation Bldg., University of Illinois
Urbana, Illinois

HOUSTON, Fred K.
MINING ENGINEER AND GEOLOGIST
36 Nat. Bank of Montana Bldg.
Helena, Montana

HOYLE, Charles
MINING ENGINEER
Apartado 8, El Oro, Mexico
MINING ENGINEER

HUNTOON, Louis D.
MINING ENGINEER
2 Rector St., New York

HUNT Co., Robert W.
MINING ENGINEERS
Examinations and Reports of Properties and Processes, Development of Properties, Consultation Assayers and Chemists, Inspection and Tests Materials, Machinery and Structural Steel for Structures. Chicago, Ill.

HUTCHINS, John Power
CONSULTING MINING ENGINEER
Room 3700, 120 Broadway
New York

HUTCHINSON, Randolph B.
MINING ENGINEER
703 Central Building, Los Angeles, Calif.

HUTCHINSON, W. Spencer
MINING ENGINEER
201 Devonshire St., Boston, Mass.

INGALSBE, F. R.
GEOLOGICAL ENGINEER
Reports and Appraisals of Oil, Coal and Mineral Lands
Missoula, Montana

JAEGER, Frederick
CHEMIST AND METALLURGIST
Specialty: Copper refining and manufacturing of sodium cyanide
17 Gramercy Park, New York City

JANIN, Charles
MINING ENGINEER
716 Kohl Bldg., San Francisco
Cable: Charjan Code: McNeill

JENKS, Arthur W.
MINING ENGINEER AND METALLURGIST
1560 Le Roy Ave., Berkeley, Cal.
Cable: Jenksville

JENKS, T. H.
CONSULTING MINING ENGINEER
1221 Royal Court, Los Angeles, Cal.
Codes: Bedford-McNeill, Moreing & Neal

JONES, C. Colcock
CONSULTING MINING ENGINEER
Examinations, Reports and Management
920 C. C. Chapman Bldg., Los Angeles, Cal.
Code: Bedford-McNeill

JORALEMON, IRA B.
MINING ENGINEER AND GEOLOGIST
1402 California Commercial Union Bldg.,
San Francisco, Calif.

JULIAN, E. A.
MINING ENGINEER
Goldfield Consolidated Mines Exploration Co.
Crocker Bldg., San Francisco, Cal.

JÜSSEN, Edmund
2546 Warring St., Berkeley. Cal.
Code: Bedford-McNeill

HAMILTON, BEAUCHAMP and WOODWORTH
E. M. Hamilton F. A. Beauchamp S. E. Woodworth
CONSULTING METALLURGICAL ENGINEERS
Office, Chancery Bldg., 564 Market St., San Francisco
Telephone: Sutter 5266 Cable Address: Hambeau Codes: West. Union: Bed. McNeill

KEENAN, EDWARD T.,
Brewster, Florida
Hydraulic, mechanical, electrical problems in connection with Hydraulic Mining and moving of solid material by pumps.

KEENE, Amor F.
CONSULTING MINING ENGINEER
42 Broadway, New York
Cable: Kamor, New York

KELLY, Sherwin F.
MINING GEOLOGIST AND ENGINEER
Beinn A. Kyor, Lawrence, Kansas, Sole Amer Rep. Electrical Prospecting by "C. & M." Schlumberger, Paris, France. H. R. Conklin, Joplin, Mo., Methods.

KENNARD ENGINEERING CO.
MINING AND METALLURGICAL ENGRS.
Mill Design and Construction. Filtration
Hollingsworth Bldg., Los Angeles, Cal.

KENNEDY, JULIAN
ENGINEER
The Bessemer Building, Sixth St. and Duquesne Way
Pittsburgh, Penn.
Cable Address: "Engineer," Pittsburgh

KINNON, William H.
MINING ENGINEER AND METALLURGIST
210 San Francisco St., El Paso, Texas
Fallon, Nevada

KINZIE, Robert A.
MINING ENGINEER
First National Bank Bldg., San Francisco

KIRBY, Edmund B.
MINING ENGINEER AND METALLURGIST
918 Security Bldg., St. Louis
Specialty: The expert examination of mines and metallurgical enterprises

KITHIL, K. L.
CONSULTING MIN'G & INDUSTRIAL ENGINEER
Rare earths and rare metal ores. Exploration, development, ore treatment, management.
728 Ogden St., Denver, Colo.

KLEPETKO, Frank
MINING AND METALLURGICAL ENGINEER
80 Maiden Lane, New York and Apartado 708
Lima, Peru

KNOX & ALLEN,
Henry H. Knox, John H. Allen
MINING AND METAL ENGINEERS
160 Broadway, New York
Cable Address: "Allenox," New York

KREJCI, Milo W.
CONSULTING METALLURGICAL ENGINEER
Smelting and refining of copper and lead
244 Cleveland St., Orange, N. J.

KRUMB, Henry
MINING ENGINEER
Felt Bldg., Salt Lake City, Utah

KUNZ, George F.
GEM EXPERT
c/o Tiffany & Co., 401 Fifth Ave., New York

LABARTHE, Jules
METALLURGICAL ENGINEER
85 Second St., San Francisco

LAKENAN, C. B.
MINING ENGINEER
McGill, Nevada

LASIER, Frederick G.
MINING ENGINEER
Holly, Mich., or c/o Detroit Club, Detroit, Mich.

LATHAM, Marc L.
Treatment of Gold and Silver Concentrates
Angels Camp, Cal.

LAWTON, Nathan O.
MINING ENGINEER
Examinations, Reports, Management; Years of Experience. Boston Bldg., Salt Lake City, Utah

LEHMANN, Charles
MINING ENGINEER
Examination and Management of Properties
Casilla, 1364, Santiago, Chile, S. A.

LE FEVRE, S.
CONSULTING MINING ENGINEER
Magnetic Iron Ore. Testing Laboratory Available
Forest Glen, Ulster County, N. Y.

LEVENSALER, L. A.
MINING ENGINEER
512 Hoge Bldg., Seattle, Wash.

LINDBERG, Carl O.
MINING ENGINEER
1218 Pacific Mutual Life Bldg., Los Angeles, Cal.
Cable: "Carlind" Code: Smelters and Bedford-McNeill

LINDLEY, Curtis, Jr.
MINING ENGINEER
604 Mills Bldg., San Francisco, Cal.

LINDSLEY, Thayer
MINING GEOLOGIST
Peterboro, N. H.

LINTON, Robert
MINING ENGINEER
120 Broadway, New York City
Code: Bedford-McNeill

LLOYD, R. L.
METALLURGICAL ENGINEER
Specialty: Pyro-Metallurgy of Copper and Associated Metals. 29 Broadway, New York
Cable: Rieloy Code: McNeill & Miners & Smelters

LOCKE, Augustus
MINING GEOLOGIST
788 Mills Bldg., San Francisco, Cal.

LONGYEAR COMPANY, E. J.
MINING ENGINEERS
Diamond Core Drilling, Shaft Sinking and Mine Development, Diamond Drill Manufacturing
Security Bldg., Minneapolis, Minn.
Cable: Longco Code: McNeill

LONG, Frederic H.
CONSULTING MINING AND METALLURGICAL ENGINEER
38 So. Dearborn St., Chicago, Ill.

Bewick, Moreing & Co.

LORING, E. A.
MINING ENGINEER
62, London Wall, London, E.C., 2
Cable: Ringlo Usual Codes

LORING, W. J.
MINING ENGINEER
Specialty: Mine Management and Examination of Mining Properties
614 Crocker Bldg., San Francisco, Cal. and c/o Bewick Moreing & Co., 62 London Wall, London E.C.2
Cable: Wantoness Usual Codes

LOVEMAN, Michael H.
MINING GEOLOGIST
36th floor. Telephone Barclay 7583
233 Broadway, New York

LUCKE, P. K.
CONSULTING MINING ENGINEER
Avenida Isabela La Catolica, Num. 25
Mexico City
Cable: Lucke, Mexico City

LUNT, Horace F.
MINING ENGINEER
617 Majestic Bldg., Denver, Colo.

MacBOYLE, Errol
MINING ENGINEER AND GEOLOGIST
1112 Hobart Bldg., San Francisco
Cable: "MacBoyle," San Francisco. Usual Codes

MacDONALD, Bernard
CONSULTING MINING ENGINEER
Calle Colegio No. 3
Parral, Chihuahua, Mexico
P. O. Address, Apto. 54 Code: Bedford-McNeill

MAJOR, Charles Edward
REGISTERED MINING ENGINEER
P.O. Box 474, Prescott, Arizona

MARSHALL, N. C.
MINING ENGINEER
Buenaventura, Colombia
South America

MARTIN, H. Rose
MINING ENGINEER AND METALLURGIST
"Milo." Consultant, Executive, Investigations, Reports. Africa, South of Equator.
63 Cullinan Bldg., Johannesburg. Telegrams

MATHEWSON E. P.
CONSULTING ENGINEER
Non-Ferrous Metallurgy
42 Broadway, New York

MAYER, LUCIUS W.
MINING ENGINEER
Rogers, Mayer & Ball, 42 Broadway, New York
Cable Address: Alhasters

H. G. McClain W. P. Cary
McCLAIN & CARY
MINING & METALLURGICAL ENGINEERS
Geology, Mill Design, Management
Leadville, Colorado

McDERMOTT, E. D.
MINING ENGINEER
The Dene Boro Green, Kent, England

McGREGOR, A. G.
ENGINEER
Design of Metallurgical Plants
Warren, Arizona

MEAD, H. L.
MINING ENGINEER
American Cyanamid Co.
511 Fifth Ave., New York

MERRILL COMPANY, THE
Charles W. Merrill, Pres.
Merrill Zinc Dust Precipitation Process, Crowe Vacuum Precipitation Process, The Merco Nordstrom Plug Valve
121 Second St., San Francisco, Cal.

MILLS & MANNING, Inc.
Hui Chang Building
Rue Linevitch, Peking, China

MINARD, Frederick H.
MINING ENGINEER
41 East 42nd St., New York City
Tel.: Murray Hill 9076
Cable: Frednard Code: McNeill

MITKE, Charles A.
CONSULTING MINING ENGINEER
Mine Ventilation—Mining Methods
Bisbee, Arizona

MOHAVE ESSAY & ENG. OFFICE
R. C. JACOBSON
REGISTERED MINING AND METALLURGICAL ENGINEER
Kingman, Arizona

MORRIS, F. L.
MINING ENGINEER
1057 Monadnock Bldg., San Francisco
Cable: Fredmor Code: McNeill

MUDD, Seeley W.
MINING ENGINEER
1203 Pacific Mutual Bldg., Los Angeles, Cal.
Code: Bedford-McNeill

MUIR, N. M.
MINING AND PETROLEUM ENGINEER
1024 Mills Bldg., San Francisco
425 Flynn Ames Bldg., Muskogee, Oklahoma

MUNRO, C. H.
MINING ENGINEER
Hobart Bldg., San Francisco
Cable: Ornum

MUNROE, H. S.
MINING ENGINEER
Anyox, British Colombia

NEILL, James W.
METALLURGIST AND MINING ENGINEER
351 California St., San Francisco, Cal.
Pasadena, Cal. Salt Lake City, Utah

NEWMAN, M. H.
MINING GEOLOGIST
c/o American Zinc, Lead & Smelting Co.
Mascot, Tenn.

NICHOLSON, Francis
CONSULTING MINING ENGINEER
36 Wes 44th Street, New York City
Consultation, Examination, Reports. Spec.: *Oil Shale*
Con. Engr. Amer. Keroleum Corp. Cable: Amkerocorp

NOTMAN, Arthur
MINING ENGINEER AND GEOLOGIST
Room 1410, 170 Broadway, New York City

NOWLAND, Ralph C.
Hobart Bldg., San Francisco
In charge Exploration Dept. of D. C. Jackling

O'KEEFFE, Edward C.
Metallurgy and Ore Dressing Tests
Flat River, Mo.

OSBORN, Walter X.
CONSULTING MINING ENGINEER
Goodsprings, Nevada

PACKARD, George A.
MINING ENGINEER AND METALLURGIST
50 Congress St., Boston, Mass.
Cable Address: "Geopack," Boston

PAYNE, Henry Mace
CONSULTING MINING ENGINEER
Machinery Club, 50 Church St., New York
Cable: Macepayne Usual Codes

PERKINS, Walter G.
62, London Wall, London, E.C. 2
Cable: Ochomdyelo

PERRET, Leon A.
CONSULTING MINING ENGINEER
Platinum and Gold Placer Mining
30 years' practical work in Siberia
100 Bluff, Yokohama, Japan

PERRY, O. B.
MINING ENGINEER
120 Broadway, New York

PICKERING, J. C.
CONSULTING MINING ENGINEER
Avenida Juarez 83, Mexico City, Mexico
Cable: Keringpic

PLATE, H. Robinson
MINING ENGINEER
Examination, Development and Management
Hobart Bldg., San Francisco, Cal.
Code: Bedford-McNeill

Howard Poillon C. H. Poirier
POILLON & POIRIER
MINING ENGINEERS
42 Broadway, New York

RAKOWSKY, Victor
MINING ENGINEER
In the development Miami Zinc Fields, Oklahoma
Address: Joplin, Mo. Code: Bedford-McNeill

REED, Avery H.
MINING ENGINEER
Zinc and Lead Ores
Fluorspar, Marion, Ky.

REID, J. A.
MINING ENGINEER
O'Brien Mine
Cobalt, Ont.

NATURAL RESOURCES DEPT.
REID NEWFOUNDLAND Co., Ltd.
St. John's, Newfoundland
Mining properties, Timber limits and water powers examined in Newfoundland and Labrador.

REID, Walter L.
CONSULTING MILL ENGINEER
The Metals Exploration Company
1213 Hobart Building, 201 14th Street
San Francisco, Calif. Denver, Colo.

RICHARDS, Gragg
MINING GEOLOGIST
201 West 81st St., New York

Robert H. Richards Charles E. Locke
RICHARDS & LOCKE MINING ENGINEERS
Careful Concentration Tests for Design of Flow Sheets for Difficult Ores
69 Massachusetts Ave., Cambridge 39, Mass.

RICKETTS, L. D.
CONSULTING ENGINEER
25 Broadway, New York

RITTER, A. Etienne
MINING ENGINEER AND GEOLOGIST
408-9 Empire Building, Denver, Colo.

RIVOIRET, M. Raymond
Ingenieur des Mines
Mortain, Manche, France

ROBBINS, P. A.
100 Prospect Ave., Highland Park, Ill.
Telephone "Highland Park 529"

ROBERTS, Milnor
MINING ENGINEER
The Pacific Northwest British Columbia and Alaska
University Station, Seattle, Wash.

ROGERS, Edwin M.
CONSULTING MINING ENGINEER
32 Broadway, New York
Cable: Emrog Code: McNeill

Allen H. Rogers, Sydney H. Ball, Lucius W. Mayer
ROGERS, MAYER & BALL
MINING ENGINEERS
42 Broadway, New York
Cable: Alhasters

ROLLER, Arthur H.
MINING AND METALLURGICAL ENGINEER
Mine Examinations, Ore Treatments and Management
438 Equitable Bldg., Denver, Colo.

ROOS, Alford
Mining Engineering, Construction, Management, Investigation, Geological Mapping, Appraisals
Bayard, Grant County, New Mexico

ROYCE, Stephen
CONSULT. MINING ENGINEER AND GEOLOGIST
Exploration, Operating, Valuation, Examination
Science Hall, Madison, Wis.
Mining Office and Residence, Crystal Falls, Mich.

RUTHERFORD, Forest CONSULTING METALLURGIST
Ore Smelting Contracts Investigated, Smelting and Milling of Copper and Lead Ores, Design and Construction
120 Broadway, New York

SAUNDERS, T. Skewes
MINING ENGINEER
Examination, Consultation and Management
University Club
Bucarcli 35, Mexico, D. F., Mexico

SCHMIDT, Henry C.
MINING ENGINEER
c/o Monterrey Foreign Club
Monterrey N. L. Mexico

SCHROTER, George A.
MINING ENGINEER
111 Broadway, New York

SEEBER, R. R.
MINING ENGINEER
Houghton, Michigan

SEMPLE, C. Carleton
MINING ENGINEER AND METALLURGIST
Apartado 162, Trujillo, Peru, So. America

SHALER, Millard K.
MINING GEOLOGIST AND ENGINEER
66 Rue de Colonies, Brussels, Belgium
Cable address: Milshaler, Bruxelles

SHEPARD, FRANK E.
MECHANICAL ENGINEER
Mining, Metallurgical and Industrial Operations.
Examinations and Reports on Western Resources.
Suite 810, Patterson Bldg., Denver, Colo.

SHIPP, E. Maltby
CONSULTING MINING, METALLURGICAL ENGINEER AND TIMBERLAND FACTOR
115 Broadway, New York City

SHORT, Frank R.
MINING ENGINEER
1057 Monadnock Bldg., San Francisco
Cable Address: "Muskeg"

SIMONDS, F. M.
MINING ENGINEER
25 Madison Ave., New York

SIMPSON, W. E.
MINING ENGINEER
Swastika, Ontario, Canada
Cable: Simpson-Swastika

SIZER, F. L.
CONSULTING MINING ENGINEER
1006 Hobart Bldg., San Francisco

SLAK, John
CONSULTING MINING ENGINEER
Examinations, Reports, Management, Exploration, Advice to Investors in Mining Properties
Mayer, Arizona

SMITH, Howard D.
MINING ENGINEER
15 Broad St., New York

Franklin W. Smith Ralph A. Ziesemer
SMITH & ZIESEMER
MINING ENGINEERS
Bisbee, Ariz. Code: McNeill

SPEARMAN, Charles
B. Sc. M. A. Min. Geologist and Engineer. Testing all Ores; Flow Sheets. Specialty: Graphite Concentration. Power Bldg. Montreal, Que.

SPENCER, L. B.
MINING ENGINEER
Reports on Nevada Mines. Mina, Nev.

SPILSBURY, P. Gybbon
MINING ENGINEER
Room 6, Berryhill Bldg., Phoenix, Ariz.

STEBBINS, Elwyn W.
MINING AND METALLURGICAL ENGINEER
814 Mills Bldg., San Francisco

STEELE, HEATH
Mining Engineer, c/o Cia Minera de Penoles, S. A., Monterey, N. Leon, Mexico

STERRETT, Douglas B.
GEOLOGIST
Mining, Petroleum
"Springland," Pierce Mill Road
Washington, D. C.

STEVENS, Arthur W.
MINING ENGINEER
Pioneerville, Idaho

STEVENS, Frank G.
MINING ENGINEER
77 Journal Bldg., Boston., Mass., and 36 Oakmount Road, Toronto, Canada

STEVENS, T. N.
Engineer U. S. Mineral Surveyor, Surface and Underground Surveys.
108 Scott St., Tucson, Ariz.

STEWART, R. H.
MINING AND METALLURGICAL ENGINEER
Vancouver Block, Vancouver, B. C.

STORM, L. W.
CONSULTING MINING ENGINEER
MINING GEOLOGIST
1313 Alaska Bldg., Seattle, Wash.

STRACHE, Walter
MINING ENGINEER
Bolsa, Commercio, Casilla 1105, Oficiana Santiago, Chile
Cable Address: "Nangoi," Santiago

STRAIN, James H.
Consulting Engineer. Examination of Mines for investors only.
With Star Mica Mining Co., 52 Broadway, N. Y., and Canaan, N. H.

STRAUSS, Lester W.
ENGINEER OF MINES
Casilla 514, Valparaiso, Chile, S. A.
Cable: Lestra-Valparaiso Code: McNeill

SUMMERHAYES, Maurice W.
MINING ENGINEER
Examinations, Diamond Drill Programs, Development and Management of Properties
Confederation Life Bldg., Toronto, Canada

SUSSMAN, Otto, Ph.D.
MINING ENGINEER
61 Broadway, New York

TAYLOR, G. Cleveland
MINING ENGINEER
U. S. Mineral Surveyor
Examination and Direction of Development
Redding, Cal. Ramsburg, Cal.

THAYER, B. B.
MINING ENGINEER
25 Broadway, New York

THORNE, W. E.
MINING ENGINEER
Medellin, Columbia, South America
Code: McNeill

TIMMONS, Colin
MINING ENGINEER
Modena, Utah

TITCOMB, H. A.
MINING ENGINEER
c/o A. Chester Beatty, 25 Broad St., New York
Code: Bedford-McNeill

TOMLINSON ENGINEERING CO.
Engineers, Metallurgists. Mine Surveys and Development. Examinations anywhere.
Venezia, Ariz.

TORBERT, James B.
MINING ENGINEER
201 Phillips Court, Owensboro, Ky.

TURNER, H. W.
MINING GEOLOGIST
593 Mills Bldg., San Francisco
Cable: Latiz Codes: McNeill-Broomhall

TURNER, J. K.
MINING ENGINEER
Goldfield, Nevada

TYRRELL, J. B.
MINING ENGINEER AND GEOLOGIST
534 Confederation Life Bldg., Toronto, Canada
208 Salisbury House, London, A.C., 2, England

VANDEGRIFT, J. A.
CONSULTING ENGINEER
115 Broadway, New York City
Cable Address: Javande, N. Y.

VAN LAW, C. W.
CONSULTING ENGINEER
Investigation, Development and Management of Mining and Petroleum Properties
Woolworth Bldg., New York City

VAN WAGENEN, H. R.
MINING ENGINEER
607 Van Nuys Bldg., Los Angeles, Calif

WALLACE, Louis R.
MINING AND METALLURGICAL ENGINEER
Forwarding Address, c/o American Express Co.
No. 11, Rue de la Scribe, Paris, France

WARD, William F.
MINING ENGINEER
Compania Mirera Choco-Pocifico Buenaventura Colombia, S. A.

WARRINER, R. C.
CONSULTING MINING ENGINEER
Room 1804, 43 Exchange Place, New York

WEBBER, Morton
MINE VALUATION AND DEVELOPMENT
165 Broadway, New York

WEEKES, Frederic R.
MINING ENGINEER
Examination and Development of Properties
233 Broadway, New York

WESTERVELT, William Young
CONSULTING MINING ENGINEER
522 Fifth Ave., New York
Cable: Casewest Code: Broomhall's

WHEELER, H. A.
MINING ENGINEER
Reports on Oil and Mining Properties
408 Locust St., St. Louis, Mo.
Cable: "Wah." St. Louis

WHITE, Charles H.
CONSULTING GEOLOGIST
788 Mills Bldg., San Francisco

WHITE, J. E.
CONSULTING ENGINEER
Bothin Bldg., Santa Barbara, California

WHITMAN, Alfred R.
MINING GEOLOGIST
Underground Programmes. Orebody Problems
University of California
Southern Branch, Los Angeles, Cal.

J. H. Devereux
WILKENS and DEVEREUX
CONSULTING MINING ENGINEERS
120 Broadway, N. Y. 7, Victoria Ave., London
Cable: Kenreux Code: Bedford-McNeill

WILSON, Ridgeway R.
MINING ENGINEER
Victoria, B. C. Canada

WITHERELL Charles S. 'Phone Beekman 4957
Metallurgical Engineer. Development, Design and Investigation of Metallurgical Plants and Processes. Thermo-Electro and Hydro Metallurgy
150 Nassau St., N. Y. Cable: "Metwith"

WISHON, W. W.
MINING ENGINEER
President of Wishon Exploration Co., Inc.
Kingman, Arizona

WOLF, Harry J.
MINING ENGINEER
42 Broadway, New York
Cable: Minewolf Codes: Bedford-McNeill

WRIGHT, Charles Will
MINING ENGINEER
Via Francesco Crispi 10, Rome (6)
Tel, 14-85. Telegraphic Address: Minesplor, Rome

WRIGHT, Ira L.
MINING ENGINEER
Examinations, Consultation and Management of Mines
Silver City, N. M.

WRIGHT, Louis A.
MINING ENGINEER
224 Warren Road, San Mateo, Calif.
Bentley's Complete Phrase Code

WROTH, James S.
MINING ENGINEER
Room 827, 2 Rector St., New York

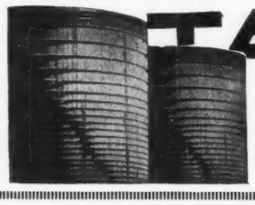
WYMAN, Henry
CONSULTING METALLURGIST
Cananea, Sonora, Mexico, Box 35

Pope Yeatman Edwin S. Berry
YEATMAN & BERRY
CONSULTING MINING ENGINEERS
Examination, Development and Management of Properties
Room 1604, 165 Broadway, New York
Cable: Ikona Code: Bedford-McNeill

ZALINSKI, Edward R.
MINING ENGINEER
524 Newhouse Bldg., Salt Lake City
Examination, Geological Mapping Development

ZEIGLER, Victor Tel.: Golden 119
GEOLOGICAL ENGINEER
Examination of oil lands and mineral deposits
Geologic and structural maps
415 Empire Bldg., Denver, Colo.

The DORR COMPANY, Engineers
New York Denver London Mexico City
Equipment for the mechanical washing, removal, recovery, classification or treatment of finely divided solids suspended in liquids.


TANKS
For All Purposes
We make tanks of any size, shape or construction you need. *Write your requirements.*
NATIONAL TANK & PIPE CO.
163 Columbia Blvd., Portland, Oregon

Mine and Mill
Machinery and Supplies
of every description
HARRON, RICKARD & McCONE
139 Townsend St. San Francisco
CALIFORNIA
225 So. San Pedro St. Los Angeles

ROOT Spiral Riveted Pipe—
Pipe Specialists for 48 Years.
ABENDROTH & ROOT MANUFACTURING COMPANY
Works: Newburgh, N. Y. New York Office: 233 Broadway

ASSAYERS, CHEMISTS AND ORE-TESTING WORKS

ATKIN & McRAE Assayers, Chemists and Metallurgists
Control and Umpire Assays
Flotation and Cyanide Tests
518-19 Jewelers Exchange Bldg.
747 South Hill St., Los Angeles, Cal.

BARDWELL, Alonzo F.
CUSTOM ASSAYER AND CHEMIST
(Successor to Bettles & Bardwell)
158 S. W. Temple St., Salt Lake City, Utah
Ore Shippers' Agent

BAVERSTOCK & PAYNE
INDUSTRIAL CHEMISTS AND ASSAYERS
Technical and Chemical Analysis of Ores
Minerals and All Organic Materials
233 W. First St., Los Angeles, Cal.

BENNETTS' CHEMICAL LABORATORY
ASSAYERS, CHEMISTS, METALLURGISTS
Ore Shippers Agent, Tacoma, Washington

BEST, Alex.
ASSAYER AND CHEMIST
Uranium and Vanadium Ores a Specialty
Idaho Springs, Colo.

BLACK & DEASON
ASSAYERS AND CHEMISTS
165 South West Temple St.
Salt Lake City, Utah

BURLINGAME, Walter E. Est. 1866
ASSAYER AND CHEMIST, ORE SHIPPERS' AGENT
Testing Laboratory, 1915 Lawrence St., Denver, Colo.

CAMERON, Geo. W.
ASSAYER AND CHEMIST
Reprensentative for shippers to the El Paso Smelter
205 San Francisco St., Box 489, El Paso, Tex.

CHASE & CO., R. E.
Ore Shippers' Representatives at the Tacoma Smelter
202 Tacoma Bldg., Tacoma, Washington

COLE & CO.
ASSAYERS, CHEMISTS, ORE BUYERS
Shippers' Representatives
Box 151, Douglas, Arizona

CRITCHETT & FERGUSON
ASSAYERS AND CHEMISTS
El Paso, Texas
Umpire and Controls a Specialty

DOLLISON, James E.
MINING ENGINEER, ASSAYER AND CHEMIST
Mine Examination and Management
Alma, Colorado

ELY, E. Prop. Dover Laboratory
ANALYSTS, ASSAYERS
Reports, Gold Assay $2.00,
Iron det. $1.00, Phos. $1.50
Dover, New Jersey

FALKENBURG & CO.
CHEMISTS, ASSAYERS, METALLURGISTS
Ore Testing—Supervision of Sampling at Smelters
116 Yesler Way, Seattle Wash.

FROST, Oscar J.
ASSAYER AND CHEMIST
1310-12 17th Ave.
P. O. Box 145, Denver, Colo.

GLOVER, WELLS & ELMENDORF
ASSAYERS AND METALLURGICAL CHEMISTS
Ore Shippers' Representatives at the Tacoma Smelter
Prefontaine Bldg., Seattle, Wash.

GENERAL ENGINEERING CO., THE J. M. CALLOW, President
CONSULTING ENGINEERS
159 Pierpont St., Salt Lake City, Utah
Design and erection of all classes of reduction plants. Ores tested in small or 5-ton lots by amalgamation, concentration, cyanidation, magnetic separation, flotation
Metallurgicl bulletin mailed upon request
New York Office, 120 Broadway, Room 3019. C. E. Chaffin, Local Manager
Australian Agent: F. H. Jackson, 22 Carrington St., Wynward Square, Sydney, N. S. W., Australia

LEDOUX & CO., Inc.
ASSAYERS, CHEMISTS AND METALLURGISTS
Independent Samplers at the Port of New York
Representatives at all Refineries and Smelters on Atlantic Seaboard
Office and Laboratory: 99 John Street, New York

Examinations, Management, Geology — **SILL & SILL** — Ore Testing Research Mill Design
MINING AND METALLURGICAL ENGINEERS
1011 South Figueroa St., Los Angeles
Consulting Engineers and Managers for Mining and Milling Operations
Metallurgical Plant equipped for large scale test work

SMITH, EMERY & CO.
Ore Testing Plants at both addresses
INDEPENDENT CONTROLS AND UMPIRE ASSAYERS
Represent Shippers at Smelters, Test Ores, and Design Mills
651 Howard Street, San Francisco — 245 South Los Angeles Street, Los Angeles

SOUTHWESTERN ENGINEERING CO.
L. C. PENHOEL
E. J. ATCKISON
EDW. THORNTON
B. M. SNYDER
Consulting Engineers. Specialty; Flotation and Concentration. Ores tested in any quantity up to 5 tons. Mills designed, erected and operated.
LOS ANGELES: Hollingsworth Bldg.
NEW YORK: 50 Church St.
MEXICO CITY. 16 de Septiembre 5

GIBSON, Walter L.
Successor to
FALKENAU ASSAYING CO.
ASSAY OFFICE AND ANALYTICAL LABORATORY, SCHOOL OF ASSAYING
824 Washington St., Oakland, Cal.
Phone 8929
Umpire assays and supervision of sampling. Working tests of ores, analysis. Investigations of metallurgical an dtechnical processes.

HANKS, Abbott A.
CHEMIST AND ASSAYER
Established 1866
624 Sacramento St., San Francisco
Control and Umpire Assays, Supervision of Sampling at Smelters
Bureau of Inspection and Testing

LEONARD ENGINEERING CO.
MINING ENGINEERS, CHEMISTS, ASSAYERS, METALLURGISTS
P. O. Box 172, Boise, Idaho

LUCKHARDT CO., C. A.
ASSAYERS, METALLURGISTS, CHEMISTS
Represents Shippers at Smelters
ALLEN C. REDDING, Chief Chemist
627 Commercial St., San Francisco

McCARTHY & CO., Richard
ASSAYERS, CHEMISTS AND METALLURGISTS
56 East Granite St., Butte, Mont.

OFFICER & CO., R. H.
ORE SHIPPERS' SERVICE
Engineers' Assays, Controls, Umpires
Iron and Steel, Oil and Coal Analyses
169 S. W. Temple St., Salt Lake City, Utah

PEREZ CO., R. A.
ASSAYERS, CHEMISTS AND METALLURGISTS
(Established 1895)
120 N. Main St., Los Angeles, Cal.

PIERS, W. L.
ASSAYER AND CHEMIST
Engineers' work and control
1736 Glenarm St., Denver, Colo.

PITKIN, Inc., Lucius
WEIGHERS, SAMPLERS AND ASSAYERS
of Ores of all Descriptions
47 Fulton St., New York
Cable: Niktip

RICHARDS & SON, J. W.
ASSAYERS AND CHEMISTS
1118 Nineteenth St., Denver
Ore Shippers' Agent. Write for terms
Representatives at all Colorado smelters

ROOT & SIMPSON
Successors to Leonard & Root, established 1902
ASSAYERS AND METALLURGICAL CHEMISTS
1744 Broadway, Denver, Colo.

JOSEPH T. TERRY & CO.
CONSULTING ENGINEERS
Preferential Flotation Reagents, Ore Testing, Mill Designing, Construction
518 Felt Bldg., Salt Lake City, Utah

UNION ASSAY OFFICE, INC.
ASSAYERS AND CHEMISTS
Box 1446, Salt Lake City, Utah

VAN CLEVE LABORATORIES, Inc.
ANALYTICAL AND CONSULTING CHEMISTS AND ASSAYERS
Ores, Metallurgical Products and Coal, Our Specialty
322 So. Fourth St., Minneapolis, Minn.

WARING & WILLIAMS
INDUSTRIAL AND ANALYTICAL CHEMISTS
Analyses, Tests, Metals, Ores, Zinc-Lead Reports
Joplin, Mo.

WOOD ASSAYING CO., Henry E.
Established 1878
ASSAYERS AND CHEMISTS
1750 Arapahoe St., Denver, Colo.
P. O. Box 1318

New cards, changes of copy, corrections or cancellations effective with first issue of each month following receipt.

ROTARY CAR-DUMPERS FOR MINE CARS (GRAVITY, ELECTRICAL OR PNEUMATIC DRIVE)
"SOLIDCAR" SELF-DUMPING CAGES CAR CONTROL AND CAGING EQUIPMENT
CHICAGO ILL.
CAR-DUMPER & EQUIPMENT CO.
PITTSBURGH PA.
THE MECHANICAL SPRAGGER AUTOMATIC TRIP CONTROL EQUIPMENT
ROTARY CAR-DUMPERS FOR STANDARD GAUGE RAILROAD CARS
Represented by Lake Shore Engine Works, Marquette, Mich.

OTTUMWA IRON WORKS
OTTUMWA, IOWA
Manufacturers of
Electric and Steam Hoisting Engines and Mine Equipment
Ottumwa Patent ROLLER BEARING TRUCKS
For Mine and Industrial Cars

The Greenawalt Sintering Apparatus and Process
John E. Greenawalt
110 East 42nd Street
New York, N. Y.
W. E. Greenawalt
85 South Sherman Street
Denver, Colorado

The
West Virginia Rail Co.
Manufacturers
Light Steel Rails
and Accessories
8-12-16-25-30-35-40-45-50-lbs. per yd.
Huntington, W. Va.

WHAT AND WHERE TO BUY

A Classified Index of Advertisers in This Issue

For Alphabetical Index see Last Page

Acetylene Dissolved
Prest-O-Lite Co.

Acids
Grasselli Chemical Co.

Acid, Sulphuric
American Zinc, Lead & Smelting Co.
Grasselli Chemical Co.
Illinois Zinc Co.
Matthiessen & Hegeler Zinc Co.

Aerial Tramways
Amer. Steel & Wire Co.
Interstate Equip. Corp.

Aftercoolers, Air
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Agitators
Allis-Chalmers Mfg. Co.
Dorr Co., The

Aluminum
Rogers, Brown & Co.

Amalgamators
Allis-Chalmers Mfg. Co.
Mine & Smelter Supply Co.

Analytical Apparatus
Braun Corporation
Braun-Knecht-Heimann-Co.
Denver Fire Clay Co.

Arsenic
Amer. Smelting & Refining Co.
U. S. Smelting, Refining & Mining Co.

Assayers
Baker & Co., Inc.

Balances
Ainsworth & Sons Co.
Braun Corporation
Braun-Knecht-Heimann-Co.
Denver Fire Clay Co.
Mine & Smelter Supply Co.

Balls for Ball Mills
Taylor-Wharton Iron & Steel Co.

Belting, Conveyor
Jeffrey Mfg. Co.
Stephens-Adamson Mfg. Co.

Belting, Elevator
Robins Conveying Belt Co.

Bit Sharpeners
Little Giant Co.

Blowers
Amer. Blower Co.
Connersville Blower Co.
Roots Co., The P. H. & F. M.

Blowers, Centrifugal
Ingersoll-Rand Co.

Blowing Engines
Nordberg Mfg. Co.

Boilers
Abendroth & Root Mfg. Co.

Books, Technical
McGraw-Hill Book Co.

Brick, Chrome
Harbison-Walker Refractories Co.

Brick, Fire
Harbison-Walker Refractories Co.

Brick, Fire Clay
Denver Fire Clay Co.

Brick, Magnetic
Harbison-Walker Refractories Co.

Brick, Silica
Harbison-Walker Refractories Co.

Bridges, Ore Handling
Brown Hoisting Machy. Co.

Bridges, Suspension
Roebling's Sons Co., J. A.

Buckets, Dredging and Excavating
Marion Steam Shovel Co.
Taylor-Wharton Iron & Steel Co.

Buckets, Elevator
Brown Hoisting Mchy. Co.
Jeffrey Mfg. Co., The
Stephens-Adamson Mfg. Co.
Taylor-Wharton Iron & Steel Co.
Webster Mfg. Co.

Buckets, Grab
Brown Hoisting Machy. Co.

Buckets, Ore
Brown Hoisting Machy. Co.

Cableways
Flory Mfg. Co., S.
Interstate Equipment Corp.
Mundy Hoisting Engine Co.
Roebling's Sons Co., J. A.

Cages, Hoisting
Atlas Car & Mfg. Co.
Car Dumper & Equip. Co.

Cans
Justrite Mfg. Co.

Car Dumpers, Rotary
Car Dumper & Equip. Co.

Car Hauls
Car Dumper & Equip. Co.
Jeffrey Mfg. Co.
Link-Belt Co.
Stephens-Adamson Mfg. Co.
Webster Mfg. Co.

Carbons, Borts and Diamonds
Diamond Drill Carbon Co.

Cars
West'n Wheeled Scraper Co.

Cars, Gable Bottom
Atlas Car & Mfg. Co.
Watt Mining Car Wheel Co.

Cars, Hopper
Atlas Car & Mfg. Co.
Watt Mining Car Wheel Co.

Cars, Mine
Watt Mining Car Wheel Co.

Cars, Mine Roller Bearing
Ottumwa Iron Works

Cars, Ore
Atlas Car & Mfg. Co.
Watt Mining Car Wheel Co.

Cars, Ore, Roller Bearing
Hyatt Roller Bearing Co.

Cars, Quarry
Atlas Car & Mfg. Co.
Austin Mfg. Co.
Watt Mining Car Wheel Co.

Castings, Iron and Steel
Marion Steam Shovel Co.
Nuttall Co., R. D.
Taylor-Wharton Iron & Steel Co.

Cement Guns
Cement Gun Co., Inc.

Cement, High Temperature
Harbison-Walker Refractories Co.

Chains, Manganese
Taylor-Wharton Iron & Steel Co.

Chains, Transmission
Jeffrey Mfg. Co.
Link-Belt Co.
Stephens-Adamson Mfg. Co.

Chemical Apparatus
Braun Corporation
Braun-Knecht-Heimann-Co.
Oliver Cont. Filter Co.

Chemicals
Braun Corporation
Braun-Knecht-Heimann-Co.
Denver Fire Clay Co.
Grasselli Chemical Co.
Nichols Copper Co.

Classifiers
Allis-Chalmers Mfg. Co.
Colorado Iron Works Co.
Deister Machine Co.
Dorr Co., The
James Ore Concentrator Co.
Traylor Eng. & Mfg. Co.

Clutches, Friction
Link-Belt Co.
Stephens-Adamson Mfg. Co.

Coal Cutters
Goodman Mfg. Co.
Ingersoll-Rand Co.
Sullivan Machy. Co.

Coal and Ore Handling Machinery
Brown Hoisting Mchy. Co.
Jeffrey Mfg. Co., The
Link-Belt Co.
Stephens-Adamson Mfg. Co.

Coal Mining Plants
Webster Mfg. Co.

Cocks
Lunkenheimer Co.

Coke
Rogers, Brown & Co.

Compressors, Air
Allis-Chalmers Mfg. Co.
Bury Compressor Co.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Nordberg Mfg. Co.
Oliver Cont. Filter Co.

Compressors, Air Portable
Cement Gun Co., Inc.
Ingersoll-Rand Co.
Sullivan Machy. Co.

Compressors, Gasoline
Sullivan Machy. Co.

Concentrators, Magnetic
Dings Magnetic Separator Co.

Concentrators, Table
Allis-Chalmers Mfg. Co.
Deister Concentrator Co.
Deister Machine Co.
James Ore Concentrator Co.
Mine & Smelter Supply Co.
Traylor Eng. & Mfg. Co.

Condensers
Alberger Pump & Condenser Co.
Ingersoll-Rand Co.
Nordberg Mfg. Co.
Southwestern Engrg. Co.

Contractors, Diamond Drilling
Sullivan Mchy. Co.

Controllers
Goodman Mfg. Co.

Converters, Horizontal and Vertical
Allis-Chalmers Mfg. Co.
Traylor Eng. & Mfg. Co.

Conveying Systems
Chisholm-Moore Mfg. Co.

Conveyor Magnets
Dings Magnetic Separator Co.

Conveyors and Elevators
Allis-Chalmers Mfg. Co.
Brown Hoisting Mchy. Co.
Jeffrey Mfg. Co., The
Link-Belt Co.
Stephens-Adamson Mfg. Co.
Webster Mfg. Co.

Conveyors, Belt
Brown Hoisting Machy. Co.
Jeffrey Mfg. Co., The
Link-Belt Co.
Robins Conveying Belt Co.
Stephens-Adamson Mfg. Co.
Webster Mfg. Co.

Conveyors, Chain Flight
Webster Mfg. Co.

Conveyors, Portable
Jeffrey Mfg. Co.
Link-Belt Co.
Robins Conveying Belt Co.

Coolers
Stearns-Roger Mfg. Co.
Traylor Eng. & Mfg. Co.

Copper
American Metal Co.
American Smlg. & Refg. Co.
Balbach Smlg. & Refg. Co.
Hardy & Ruperti, Inc., Chas.
Nichols Copper Co.
U. S. Smelting, Refining & Mining Co.

Copper Sulphate
Nichols Copper Co.

Couplings, Air Hose
Cleveland Rock Drill Co.

Cranes
Chisholm-Moore Mfg. Co.

Cranes, Bridge
Brown Hoisting Mchy. Co.

Cranes, Locomotive
Brown Hoisting Machy. Co.
Hoar Shovel Co., Inc.
Link-Belt Co.

Cranes, Traveling
Chisholm-Moore Mfg. Co.
Niles-Bement-Pond Co.

Creosoting Cylinders for Treatment of Timber
Vulcan Iron Works

Crucibles
Denver Fire Clay Co.

Crushers
Allis-Chalmers Mfg. Co.
Austin Mfg. Co.
Braun Corporation, The
Braun-Knecht-Heimann-Co.
Buchanan Co., Inc., C. G.
Colorado Iron Works Co.
Jeffrey Mfg. Co., The
Mine & Smelter Supply Co.
Smith Engrg. Works
Stephens-Adamson Mfg. Co.
Traylor Eng. & Mfg. Co.

Crusher Parts
Jeffrey Manufacturing Co.
Midvale Co., The
Taylor-Wharton Iron & Steel Co.

Cupels
Denver Fire Clay Co.

Cups, Grease (See "Grease Cups")

Cyanide
Braun Corporation
Braun-Knecht-Heimann-Co.

Cyanide Plants
National Tank & Pipe Co.

Dealers, Machinery (Rails, Pipe & Misc. Equipment)
Aluminum Co. of America
Morse Bros. Machy. & Supply Co.
Old Hickory Powder Plant
Olds, H. A.
Rosenburg & Co.
Thyle Machinery Co.

Derricks
Mundy Hoisting Engine Co.

Dewaterers
Oliver Cont. Filter Co.

Diamonds, Black (See "Carbons and Bortz")

Dippers, Steam Shovel
Taylor-Wharton Iron & Steel Co.

Dipper Teeth, Steam Shovel
Taylor-Wharton Iron & Steel Co.

Dissolved Acetylene
Prest-O-Lite Co.

Dredges
Hoar Shovel Co., Inc.
Marion Steam Shovel Co.
Morris Machine Works
New York Engineering Co.
Union Construction Co.
Yuba Manufacturing Co.

Dredges, Dipper & Hydraulic
Bucyrus Co.

Dredges, Elevator
Marion Steam Shovel Co.

Dredges, Placer
Bucyrus Co.

Dredging Machinery
Mundy Hoisting Engine Co.

Drills, Air
Chicago Pneumatic Tool Co.

Drills, Air and Steam
Cleveland Rock Drill Co.
Ingersoll-Rand Co.

Drills, Churn
Union Construction Co.

Drilling, Core
Sullivan Machinery Co.

Drills, Core
Std. Diamond Drill Co.
Sullivan Machinery Co.

Drills, Diamond
Std. Diamond Drill Co.
Sullivan Machinery Co.

Drills, Electric
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Jeffrey Mfg. Co., The

Drills, Hammer
Chicago Pneumatic Tool Co.
Cleveland Rock Drill Co.
Cochise Rock Drill Mfg. Co.
Denver Rock Drill Mfg. Co.
Hardsocg Wonder Drill Co.
Ingersoll-Rand Co.
Sullivan Machinery Co.

Drills, Piston
Cochise Rock Drill Mfg. Co.
Ingersoll-Rand Co.
Sullivan Machinery Co.

Drills, Prospecting
Ingersoll-Rand Co.
New York Engineering Co.
Std. Diamond Drill Co.
Sullivan Machinery Co.

Drums, Magnetic
Dings Magnetic Separator Co.

Dryers, Centrifugal
Sturtevant Co., B. F.

Dryers, Ore
Allis-Chalmers Mfg. Co.
Traylor Eng. & Mfg. Co.
Vulcan Iron Works

Dryers, Sand and Coal
Vulcan Iron Works

Dumps, Rotary
Car Dumper & Equip. Co.

Dust Protectors (See "Respirators")

Dynamite
Hercules Powder Co.

Electrical Supplies
Ohio Brass Co.

Elevators
Austin Mfg. Co.

Elevators, Bucket
Jeffrey Mfg. Co., The
Link-Belt Co.
Stephens-Adamson Mfg. Co.
Traylor Eng. & Mfg. Co.

Engineers, Metallurgical
Dorr Co., The
Southwestern Engrg. Co.

Engines, Diesel
Allis-Chalmers Mfg. Co.
Nordberg Mfg. Co.

Engines, Gas and Gasoline
Chicago Pneu. Tool Co.

Engines, Hoisting
Mundy Hoisting Engine Co.
Ottumwa Iron Works

Engines, Oil
Chicago Pneu. Tool Co.
Ingersoll-Rand Co.
Nordberg Mfg. Co.

Engines, Steam
Allis-Chalmers Mfg. Co.
Ingersoll-Rand Co.
Nordberg Mfg. Co.

Excavating Machinery
Marion Steam Shovel Co.

Excavators, Dragline
Bucyrus Co.
Link-Belt Co.
Marion Steam Shovel Co.

Exhausters
Amer. Blower Co.
Connersville Blower Co.
Sturtevant Co., B. F.

Explosives
Hercules Powder Co.

Extinguishers, Fire
Justrite Mfg. Co.

Fans, Ventilating
Amer. Blower Co.
Jeffrey Mfg. Co., The
Ottumwa Iron Works
Sturtevant Co., B. F.

Feeders, Ore
Colorado Iron Works Co.
James Ore Concentrator Co.
Jeffrey Mfg. Co., The
Link-Belt Co.
Stephens-Adamson Mfg. Co.
Traylor Eng. & Mfg. Co.

Ferro Alloys
Rogers, Brown & Co.

Filter Cloth
Filter Fabrics Co.

Filter Paper
Braun Corporation
Braun-Knecht-Heimann-Co.
Denver Fire Clay Co.

Filters
Colorado Iron Works Co.
Oliver Cont. Filter Co.
United Filters Corp.

Filters, Cloth Metallic
Oliver Cont. Filter Co.
Tyler Co., The W. S.
United Filters Corp.

Filters, Concentrate
Oliver Cont. Filter Co.

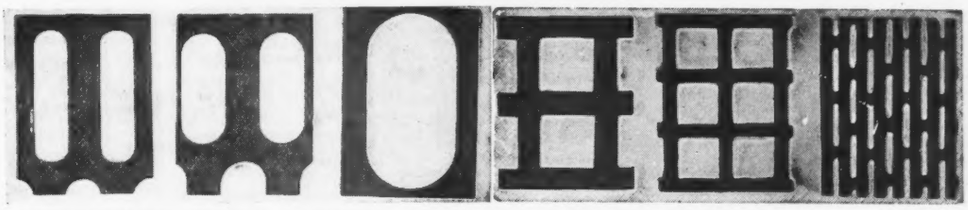
Filters, Cyanide
Oliver Cont. Filter Co.

Flotation Cell Bottoms, Cloth
Filter Fabrics Co.

Flotation Machines
Southwestern Engrg. Co.

PERFORATED METAL

All sizes and shapes of Holes



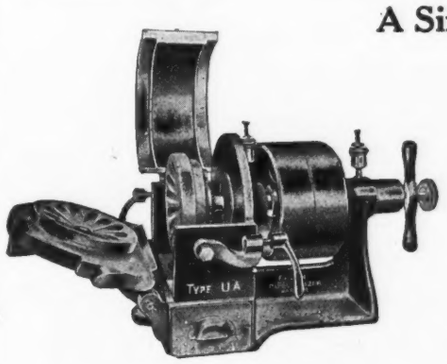
All kinds and thicknesses of Metal

FOR SCREENING ORES—ROCK—GRAVEL—SAND—COAL AND ALL MINERALS

Harrington & King Perforating Company

5641 Fillmore St., Chicago, Ill., U. S. A. New York Office: 114 Liberty Street

---



A Simple Straight Drive Laboratory Pulverizer

BRAUN TYPE UA

NO GEARS OR TROUBLE BREEDERS
ALWAYS READY—NOTHING TO GET OUT OF ORDER
REPLACEABLE BABBITTED BUSHINGS

PULVERIZERS FROM ¼ inch to 80 mesh with one grinding.
Machine complete, with one set of grinding plates (shipping weight 275 lbs.) $135.00
Extra Grinding plates, made of a special tough alloy steel, per set... 8.00

THE BRAUN CORPORATION

San Francisco House Braun-Knecht-Heimann-Co. LOS ANGELES, CALIF, U. S. A.

BRAUN SERVICE IS WORLD WIDE

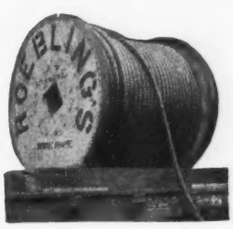
Over 75% of the mines of the world are equipped with Braun Laboratory Machinery

---

When you need air, gas, or liquids in known, definite volumes, think first of ROOTS Rotary Blowers, Gas Pumps, Vacuum Pumps and Pumps for liquids. The ROOTS Positive Displacement Blower is the original patented in 1859. The R.P.M. is an indication of volume delivered. Write us your requirements today so that we can send you copy of valuable bulletin "ENGINEERING TABLES" Free. Ask for Bulletin J-118.

CHICAGO OFFICE 122 S. Michigan Ave. **The P.H. & F.M. ROOTS CO.** NEW YORK OFFICE 120-122 Liberty St.
CONNERSVILLE, IND.

ROOTS



ROEBLING WIRE ROPE

Wire Rope Fittings
Wire Rope Slings
Welding Wire

John A. Roebling's Sons Company
Trenton, New Jersey

BRANCHES:
New York Boston Chicago Philadelphia Pittsburgh Cleveland
Atlanta San Francisco Los Angeles Seattle Portland, Ore.

CEMENT-GUN

Trade Mark

And the Traylor Mine Type Compressor

See our half page ad in the last issue and the next issue.

Cement-Gun Co., Inc., Allentown, Pa.

Blowers *Exhausters*

The Connersville Blower Co.

Connersville, Ind.

Boosters *Pumps*

Laboratory Supplies
Fire Clay Products

DFC

Metallurgical Furnaces
Oil Burners

THE DENVER FIRE CLAY COMPANY

Denver, Colorado, U. S. A.

El Paso, Texas Utah Dept., Salt Lake City

"Sirocco" Fans and "Ventura" Fans for Mine Ventilation

Complete Engineering Service

American Blower

"Sirocco" TRADE MARK

AMERICAN BLOWER COMPANY, DETROIT

(255)

Flotation Oils
General Naval Stores Co.
Hercules Powder Co.

Fluorspar
Rogers, Brown & Co.

Forges, Rock Drill Steel
Ingersoll-Rand Co.
Sullivan Machinery Co.

Forgings, Heavy
Midvale Co., The

Furnace Facings and Linings
Denver Fire Clay Co.

Furnaces, Assay
Braun Corporation, The
Braun-Knecht-Heimann-Co.
Denver Fire Clay Co.
Mine & Smelter Supply Co.
Wile Electric Furnace & Eng'r'g Co.

Furnaces, Bullion Melting
Mine & Smelter Supply Co.
Wile Electric Furnace & Eng'r'g Co.

Furnaces, Crucible Tilting and Refining
Denver Fire Clay Co.
Mine & Smelter Supply Co.
Wile Electric Furnace & Eng'r'g Co.

Furnaces, Crucible Tilting Metal
Braun Corporation
Braun-Knecht-Heimann-Co.
Mine & Smelter Supply Co.

Furnaces, Electric
Braun Corporation
Braun-Knecht-Heimann-Co.
Denver Fire Clay Co.
Wile Electric Furnace & Eng'r'g Co.

Furnaces, Heat Treatment
Braun Corporation
Braun-Knecht-Heimann-Co.
Denver Fire Clay Co.
Wile Electric Furnace & Eng'r'g Co.

Furnaces, Mechanical Roasting
Allis-Chalmers Mfg. Co.
Bethlehem Fdry. & Mch. Co.
Colorado Iron Works Co.
Dwight & Lloyd Sintering Co.
Mine & Smelter Supply Co.
Traylor Eng. & Mfg. Co.

Furnaces, Melting
Braun Corporation
Braun-Knecht-Heimann-Co.
Denver Fire Clay Co.

Furnaces, Smelting
Allis-Chalmers Mfg. Co.
Traylor Eng. & Mfg. Co.
Wile Electric Furnace & Eng'r'g Co.

Gas Compressors
Ingersoll-Rand Co.

Gas, Dissolved
Prest-O-Lite Co.

Gas, Welding and Cutting
Prest-O-Lite Co.

Gates, Blast
Amer. Blower Co.

Gears
Fawcus Machine Co.
Jeffrey Mfg. Co., The
Niles-Bement-Pond Co.
Nuttall Co., R. D.
Stephens-Adamson Mfg. Co.
Taylor-Wharton Iron & Steel Co.

Gears, Herringbone
Falk Corporation, The
Fawcus Machine Co.
Niles-Bement-Pond Co.
Sturtevant Co., B. F.

Glass Blowing
Denver Fire Clay Co.

Glassware, Chemical
Denver Fire Clay Co.

Gravel Washing Plants
Stephens-Adamson Mfg. Co.

Grease Cups
Lunkenheimer Co., The
Powell Co., The Wm.

Grinders, Air and Electric
Chicago Pneumatic Tool Co

Grinders, Chemical Ore
Braun Corporation
Braun-Knecht-Heimann-Co.
Cleveland Rock Drill Co.

Grinders, Manganoid Pebble
Jeffrey Mfg. Co., The

Grinders, Ore
Mine & Smelter Supply Co.

Grinders, Sample
Mine & Smelter Supply Co.

Hammers, Forging
Sullivan Machy. Co.

Hammers, Pneumatic
Cleveland Rock Drill Co.

Hammers, Power
Little Giant Co.

Headlights, Incandescent Mine
Goodman Mfg. Co.
Ohio Brass Co.

Heaters, Feed Water
Alberger Pump & Cond. Co.

Heavy Dock Machinery
Brown Hoisting Machy. Co.

Hoists
Chisholm-Moore Mfg. Co.

Hoists, Air
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Hoists, Chain
Chisholm-Moore Mfg. Co.

Hoists, Electric
Allis-Chalmers Mfg. Co.
Flory Mfg. Co., S.
Link-Belt Co.
Mundy Hoisting Engine Co.
Nordberg Mfg. Co.
Ottumwa Iron Works
Vulcan Iron Works

Hoists, Friction
Austin Mfg. Co.

Hoists, Gasoline
Mundy Hoisting Engine Co.

Hoists, Mine Steam
Mundy Hoisting Engine Co.

Hoists, Portable
Ingersoll-Rand Co.
Sullivan Machy. Co.

Hoists, Skip
Jeffrey Mfg. Co.
Link-Belt Co.

Hoists, Steam
Allis-Chalmers Mfg. Co.
Ingersoll-Rand Co.
Mundy Hoisting Engine Co.
Nordberg Mfg. Co.
Ottumwa Iron Works
Vulcan Iron Works

Hose, Air
Cleveland Rock Drill Co.
Cochise Rock Drill Mfg. Co.
Denver Rock Drill Mfg. Co.
Ingersoll-Rand Co.

Hydraulic Trip Controls
Car Dumper & Equip. Co.

Instruments, Surveying
Ainsworth & Sons Co.
Berger & Sons Co., C. L.
Buff & Buff Mfg. Co.
Gurley, W. & L. E.

Insulating Material, Electric
Ohio Brass Co.

Jackets, Water
Allis-Chalmers Mfg. Co.
Traylor Eng. & Mfg. Co.

Jigs
Allis-Chalmers Mfg. Co.
Colorado Iron Works Co.
James Ore Concentrator Co.

Joints, Expansion
Alberger Pump & Cond. Co.
Lunkenheimer Co.

Kilns, Rotary
Allis-Chalmers Mfg. Co.
Traylor Eng. & Mfg. Co.
Vulcan Iron Works

Laboratory Machinery
Braun Corporation, The
Braun-Knecht-Heimann-Co.
Denver Fire Clay Co.
Mine & Smelter Supply Co.
Oliver Cont. Filter Co.

Lamps, Acetylene
Braun Corporation
Braun-Knecht-Heimann-Co.
Dewar Mfg. Co.
Grier Bros. Co.
Justrite Mfg. Co.

Lead
American Metal Co.
American Smlg. & Ref. Co.
Am. Zinc, Lead & Smlg. Co.
Balbach Smelting & Refining Co.
Hardy & Ruperti, Inc., Chas.
U. S. Smelting, Refining & Mining Co.

Line Material, Overhead
Ohio Brass Co.

Linings, Ball and Tube Mill
Allis-Chalmers Mfg. Co.
Taylor-Wharton Iron & Steel Co.
Traylor Eng. & Mfg. Co.

Loading Booms, Adjustable
Jeffrey Mfg. Co., The
Webster Mfg. Co.

Loading Machines, Pneumatic
Lake Superior Loader Co.

Loaders, Wagon
Jeffrey Mfg. Co., The
Link-Belt Co.

Locomotives, Electric
Goodman Mfg. Co.
Jeffrey Mfg. Co., The

Locomotives, Electric Storage Battery
Atlas Car & Mfg. Co.
Goodman Mfg. Co.
Jeffrey Mfg. Co., The
Whitcomb Co., Geo. D.

Locomotives, Gasoline
Fate-Root-Heath Co.
Vulcan Iron Works
Whitcomb Co., Geo. D.

Locomotives, Industrial
Fate-Root-Heath Co.
Goodman Mfg. Co.
Jeffrey Mfg. Co., The
Whitcomb Co., Geo. D.

Locomotives, Mine
Fate-Root-Heath Co.
Goodman Mfg. Co.
Jeffrey Mfg. Co., The
Whitcomb Co., Geo. D.

Locomotives, Steam
Vulcan Iron Works

Log Washers, Magnetic
Dings Magnetic Separator Co.

Lubricators
Lunkenheimer Co.

Machine Tools
Niles-Bement-Pond Co.

Magnets, Electro
Dings Magnetic Separator Co.

Magnets, High Intensity
Dings Magnetic Separator Co.

Magnets, Safety
Dings Magnetic Separator Co.

Manufacturers Representatives
Harron, Rickard & McCone

Material Handling Equipment
Chisholm-Moore Mfg. Co.

Metals, Perforated
Allis-Chalmers Mfg. Co.
Harrington & King Perforating Co., The
Hendrick Mfg. Co.

Mills, Ball, Tube and Pebble Rod
Allis-Chalmers Mfg. Co.
Colorado Iron Works Co.
Mine & Smelter Supply Co.

Mills, Stamp
Allis-Chalmers Mfg. Co.

Mineral Magnetic Separators
Dings Magnetic Separator Co.

Mixers
Smith Eng. Works

Monel Metal
International Nickel Co.

Motor Generator Sets
Atlas Car & Mfg. Co.

Motors
Allis-Chalmers Mfg. Co.

Motors, Air
Chicago Pneumatic Tool Co.

Motors, Compressed Air
Ingersoll-Rand Co.

Motors, Electric
Sturtevant Co., B. F.

Mucking Machines
Lake Superior Loader Co.

Netting, Wire
Ludlow-Saylor Wire Co.

Nickel
Amer. Smelting & Refining Co.
Internatinoal Nickel Co.
Nichols Copper Co.

Nodulizers, Ore
Allis-Chalmers Mfg. Co.

Oil Cups
Lunkenheimer Co.

Oil, Pine
General Naval Stores Co.
Hercules Powder Co.

Oil Storage Tanks
American Bridge Co.

Ore, Buyers and Sellers of
American Metal Co.
Am. Smelting & Refining Co.
Am. Zinc, Lead & Smlg. Co.
Balbach Smlg. & Ref. Co.
Bartlesville Zinc Co.
Grasselli Chemical Co.
Hardy & Ruperti, Inc., Chas.
Illinois Zinc Co., The
International Smelting Co.
Irvington Smelting & Refining Works
Matthiessen & Hegeler Zinc Co.
Phelps-Dodge Corp.
United Metals Selling Co.
U. S. Metals Refining Co.
United States Smelting Refining & Mining Co.

Overhead Line Material
Ohio Brass Co.

Overhead Track Systems
Chisholm-Moore Mfg. Co.

Packing
Crandall Packing Co.
Greene, Tweed & Co.

Penstocks
Amer. Spiral Pipe Works

Perforated Metals (See Metals, Perforated)

Picking Tables
Webster Mfg. Co.

Pipe, Spiral, Riveted
Abendroth & Root Mfg. Co.
Amer. Spiral Pipe Works

Pipe, Steel Welded
Amer. Spiral Pipe Works

Platinum
Baker & Co., Inc.

Pneumatic Hammers
Chicago Pneumatic Tool Co.

Pneumatic Tie Tampers
Ingersoll-Rand Co.

Pneumatic Tools
Chicago Pneumatic Tool Co.
Cleveland Rock Drill Co.
Ingersoll-Rand Co.

Powder, Blasting
Grasselli Chemical Co.
Hercules Powder Co.

Power Transmission, Mchy.
Stephens-Adamson Mfg. Co.
Webster Mfg. Co.

Preservative, Wood (See Creosote)

Presses, Filter
Oliver Cont. Filter Co.
Shriver & Co., T.
United Filters Corp.

Publishers, Technical Book
McGraw-Hill Book Co.

Pulleys, Magnetic
Buchanan Co., Inc., C. G.
Dings Magnetic Separator Co.

Pulverizers, Coal
Braun Corporation
Braun-Knecht-Hennann-Co.
Jeffrey Mfg. Co., The

Pulverizers, Ore
Braun Corporation, The
Braun-Knecht-Heimann-Co.
Colorado Iron Works Co.
Jeffrey Mfg. Co., The
Mine & Smelter Supply Co.

Pumping Engines
Nordberg Mfg. Co.
Prescott Co., The

Pumps, Acid
Oliver Cont. Filter Co.
Westco-Chippewa Pump Co.

Pumps, Boiler Feed
Ingersoll-Rand Co.
Westco-Chippewa Pump Co.

Pumps, Centrifugal
Alberger Pump & Cond. Co.
Ingersoll-Rand Co.
Krogh Pump & Machy. Co.
Morris Machine Works
Oliver Cont. Filter Co.
Pelton Water Wheel Co.
Westco-Chippewa Pump Co.
Wilfley & Sons, A. R.

Pumps, Deep Well
Ingersoll-Rand Co.
Krogh Pump & Mchy. Co.
Westco-Chippewa Pump Co.

Pumps, Electric
Alberger Pump & Cond.Co.
Ingersoll-Rand Co.
Krogh Pump & Mchy. Co.
Oliver Cont. Filter Co.
Prescott Co., The
Traylor Eng. & Mfg. Co.
Westco-Chippewa Pump Co.
Wilfley & Sons, A. R.

Pumps, Hydraulic
Prescott Co., The
Traylor Eng. & Mfg. Co

Pumps, Mill
Colorado Iron Works Co.
Ingersoll-Rand Co.
Krogh Pump & Machy. Co
Morris Machine Works
Oliver Cont. Filter Co.
Prescott Co., The
Roots Co., The P. H. & F. M.
Traylor Eng. & Mfg. Co.
Westco-Chippewa Pump Co.
Wilfley & Sons, A. R.

Pumps, Mine
Allis-Chalmers Mfg. Co.
Ingersoll-Rand Co.
Krogh Pump & Mchy. Co.
Morris Machine Works
Prescott Co., The
Roots Co., The P. H. & F. M.
Westco-Chippewa Pump Co.

Pumps, Pneumatic Air Lift
Ingersoll-Rand Co.
Sullivan Machinery Co.

Pumps, Power Plant
Alberger Pump & Cond. Co.
Ingersoll-Rand Co.
Morris Machine Works
Prescott Co., The
Roots Co., The P. H. & F. M.
Traylor Eng. & Mfg. Co.
Westco-Chippewa Pump Co.

Pumps, Reciprocating
Prescott Co., The
Traylor Eng. & Mfg. Co.
Westco-Chippewa Pump Co.

Pumps, Sand, Slime and Tailings
Dorr Co., The
Krogh Pump & Machy o.
Morris Machine Works
Taylor-Wharton Iron & Steel Co.
Wilfley & Sons, A. R.

Pumps, Sinking
Ingersoll-Rand Co.
Prescott Co., The

Pumps, Steam
Ingersoll-Rand Co.
Oliver Cont. Filter Co.
Prescott Co., The

Pumps, Vacuum
Chicago Pneu. Tool Co.
Connersville Blower Co.
Ingersoll-Rand Co.
Roots Co., The P. H. & F. M.
Sullivan Machinery Co.

Rail Bonds
Ohio Brass Co.

Rail Bonding Tools
Ohio Brass Co.

Rails, Light Steel
West Virginia Rail Co.

Receivers, Air
Chicago Pneumatic Tool Co.

Refractories
Braun Corporation
Braun-Knecht-Heimann-Co.

Riddles, Wire
Ludlow-Saylor Wire Co.

Roll Shells
Midvale Co., The

Rolls, Crushing (See "Crushers")

Rope, Wire
Amer. Steel & Wire Co.
Leschen & Sons Rope Co., A.
Roebling's Sons Co., John A.

Safety Magnets
Dings Magnetic Separator Co.

Samplers, Ore
Allis-Chalmers Mfg. Co.
Traylor Eng. & Mfg. Co.

Scraper Loaders
Goodman Mfg. Co.

Screens
Allis-Chalmers Mfg. Co.
Austin Mfg. Co.
Colorado Iron Works Co.
Deister Concentrator Co.
James Ore Concentrator Co.
Link-Belt Co.
Stephens-Adamson Mfg. Co.
Taylor-Wharton Iron & Steel Co.

Screens, Incline, Vibratory
Jeffrey Mfg. Co.
Tyler Co., The W. S.

Screens, Perforated Metal
Allis-Chalmers Mfg. Co.
Chicago Perforating Co.
Harrington & King Perforating Co., The
Hendrick Mfg. Co.

Screens, Revolving
Allis-Chalmers Mfg. Co.
Buchanan Co., Inc., C. G.
Colorado Iron Works Co.
Harrington & King Perforating Co., The
Stephens-Adamson Mfg. Co.
Traylor Eng. & Mfg. Co.

Screens, Rolled Slot
Ludlow-Saylor Wire Co.

Screens, Vibrating
Southwestern Engrg. Co.

Screens, Wire
Ludlow-Saylor Wire Co.
Tyler Co., The W. S.

Second-Hand Machinery (See Searchlight Section)
Aluminum Co. of America
Morse Bros. Mach. & Supply Co.
Old Hickory Powder Plant
Olds, H. A.
Rosenburg & Co.
Thyle Machy. Co.

Selenium
Amer. Smelting & Refining Co.
Nichols Copper Co.

Separators, Inclined Vibrating Screen
Tyler Co., The W. S.

Only 52 cu. ft. at 85 lb.

Cochise Rock Hammers really utilize the expansion force of compressed air. That is why they use so little air—20% to 30% less than any other make drill of similar size and type.

Yet they outdrilled all other makes at the recent Bisbee Contest where they took 1st, 2nd, and 3rd places.

And they just won't wear out. A cushioning effect precisely timed, prevents the piston from hitting either *front* or back head. This reduces breakage, lost time, and repair costs to a minimum.

WRITE TODAY FOR BULLETIN A36-2D

Sold by

Cochise Rock Drill Mfg. Co., Los Angeles, Calif.
The Mine & Smelter Supply Co., Salt Lake City, Utah
The Arizona Mine Supply Co., Prescott, Ariz.
A. H. Cox & Co., Inc., Seattle, Wash.
General Machinery Co., Spokane, Wash.
Jack Aylward, Goldfield, Nev.
Sidney E. Mayer Co., San Diego, Calif.
S. P. Wright & Co., Inc., Butte, Mont.
Jewell Commercial Co., Randsburg, Calif.
Robertson & Moss, Johannesburg, South Africa

Manufactured by

Cochise
ROCK DRILL MFG. CO., LOS ANGELES, CAL.

THE WORLD'S MOST RELIABLE DIAMOND DRILL CONTRACTORS
EXPERIENCE
SINCE 1884
SULLIVAN MACHINERY CO
126 SO. MICHIGAN AVE. CHICAGO, ILL.

Speed—Economy—Results.
Send for Bulletins

HARDSOCG DRILLS

Hardsocg Wonder Drill Co., Ottumwa, Iowa.

DIAMOND DRILLS

Hand Power, Gasoline, Steam, Air, Electricity.
Send for Catalogue No. 6.

STANDARD DIAMOND DRILL COMPANY
745 First National Bank Building, Chicago, U. S. A.

SINTER YOUR FINE ORES

Special Problems in Ore Treatment

DWIGHT & LLOYD SINTERING CO., Inc.
29 Broadway New York City
Cable Address: "Sinterer—New York"

More Footage *for* Less Money

The reserve supply of air in the Pocket-in-Head insures you of a uniform, snappy blow.

A uniform blow increases a drill's capacity for work, and increased capacity means greater footage. That's easy. Then why not write us for the details?

Ask for Bulletins 49 and 35A

The Cleveland Rock Drill Company
3734 East 78th Street
CLEVELAND, OHIO
EASTERN HEADQUARTERS:
Room 526, 30 Church St., New York City
PACIFIC COAST HEADQUARTERS:
126 O Street, Sacramento, Calif.
MIDDLE WEST HEADQUARTERS:
905 14th St., Denver, Colo.
SALT LAKE OFFICE:
419 Dooly Bldg., Salt Lake City, Utah
Canadian Trade Supplied by
Cleveland Pneumatic Tool Co. of Canada, Ltd.
Toronto, Ont.

Cleveland
POCKET-IN-HEAD
Rotators

Separators, Magnetic
Buchanan Co., Inc., C. G.
Stearns-Roger Mfg. Co.
Separators, Magnetic Wet
Dings Magnetic Separator Co.

Sharpeners, Drill
Denver Rock Drill Mfg. Co.
Ingersoll-Rand Co.
Sullivan Machinery Co.

Sheaves
Taylor-Wharton Iron & Steel Co.

Shoveling Machines
Lake Superior Loader Co.

Shovels, Electric
Marion Steam Shovel Co.

Shovels, Gasoline
Marion Steam Shovel Co.

Shovels, Power
Bucyrus Co.

Shovels, Steam, Gas and Electric
Hoar Shovel Co., Inc.
Marion Steam Shovel Co.

Silent Chain Drives
Link-Belt Co.

Sintering Apparatus
Dwight & Lloyd Sintering Co.

Skips
Atlas Car & Mfg. Co.

Smelters
American Smlg. & Ref. Co
Am. Zinc, Lead & Smlg. Co.
Balbach Smlg. & Ref. Co.
Grasselli Chemical Co.
Illinois Zinc Co.
International Smelting Co.
Matthiessen & Hegeler Zinc Co.
Nichols Copper Co.
U. S. Metal Selling Co.
U. S. Smelting, Refining & Mining Co.

Smelting Machinery
Greenawalt, John E.

Spelter
Amer. Metal Co., Ltd., The
Amer. Smelt. & Ref. Co.
Amer. Zinc, Lead & Smelt. Co.
Grasselli Chemical Co.
U. S. Smelting, Refining & Mining Co.

Spouts, Magnetic
Dings Magnetic Separator Co.

Steam Specialties
Powell Co., The W.

Steel, Drill
Chicago Pneumatic Tool Co.
Cochise Rock Drill Mfg. Co.
Colonial Steel Co.
Ingersoll-Rand Co.
Midvale Co., The

Steel, High-Speed
Colonial Steel Co.

Steel, Hollow & Solid
Colonial Steel Co.

Steel, Manganese
Taylor-Wharton Iron & Steel Co.

Steel, Tool
Colonial Steel Co.
Midvale Co., The

Tanks, Wood
Mine & Smelter Supply Co.
National Tank & Pipe Co.

Testing Sieves and Testing Sieve Shakers
Tyler Co., The W. S.

Thickeners
Dorr Co., The

Tractors
Yuba Manufacturing Co.

Tramways, Wire Rope, Aerial
Interstate Equipment Corp.
Leschen & Sons Rope Co., A.
Riblet Tramway Co.
Roebling's Sons Co., J. A.

Transformers, Electric
Allis-Chalmers Mfg. Co.

Trolley Line Material
Ohio Brass Co.

Trolleys
Chisholm-Moore Mfg. Co.

Tube Testers, Magnetic
Dings Magnetic Separator Co.

Tungsten
Hardy & Ruperti, Inc., Chas.

Turbines, Hydraulic
Allis-Chalmers Mfg. Co.
Pelton Water Wheel Co.

Turbines, Steam
Allis-Chalmers Mfg. Co.

Valves
Cleveland Rock Drill Co.
Lunkenheimer Co., The
Merrill Co.

Valves, Blow-off
Lunkenheimer Co., The

Valves, Check
Lunkenheimer Co., The
Powell Co., The Wm.

Valves, Gate
Lunkenheimer Co.
Powell Co., The Wm.

Valves, Globe
Lunkenheimer Co., The

Valves, Non-Return
Lunkenheimer Co., The

Valves, Pop Safety
Lunkenheimer Co., The

Valves, Pump
Crandall Packing Co.

Valves, Throttle
Lunkenheimer Co., The

Ventilators
Amer. Blower Co.
Sturtevant Co., B. F.

Water Columns
Lunkenheimer Co., The

Welders, Portable Electric
Ohio Brass Co.

Welding and Cutting Gas
Prest-O-Lite Co.

Wheels & Axles, Car
Watt Mining Car Wheel Co.

Whistles
Lunkenheimer Co., The

Wire Cloth
Ludlow-Saylor Wire Co.
Tyler Co., The W. S.

Wire, Flat, Round and Special Shape
Amer. Steel & Wire Co.
Roebling's Sons Co., John A.

Wire, Insulated
Roebling's Sons Co., John A.

Wire, Magnet
Amer. Steel & Wire Co.

Wire Rope Fittings
Roebling's Sons Co., John A.

Wire Rope Slings
Roebling's Sons Co., John A.

Wood Borers
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Wood Preservative (See Creosote)

Wrenches
Greene, Tweed & Co.

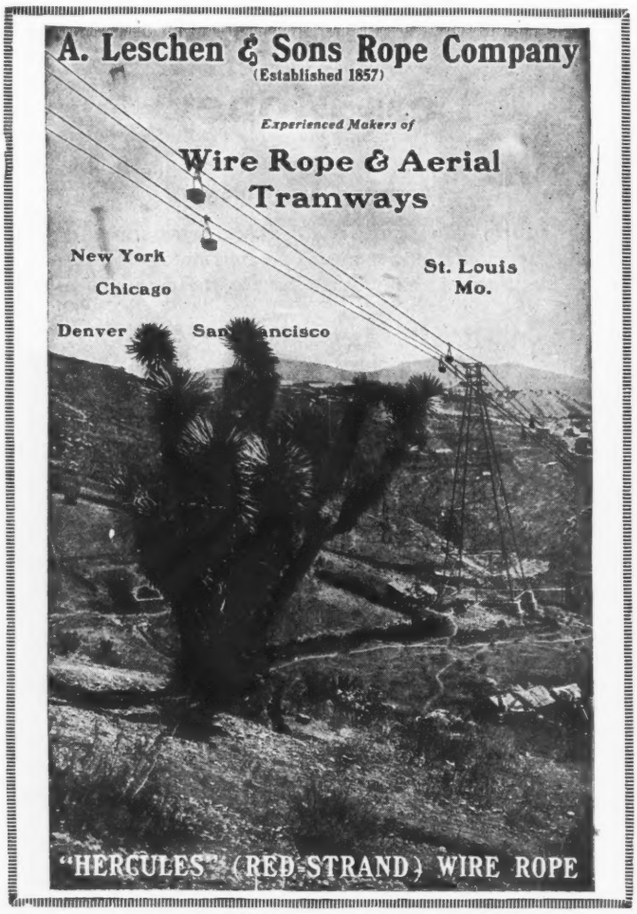
Wrenches, Alligator
Roebling's Sons Co., J. A.

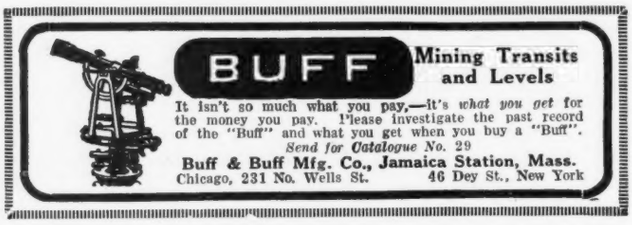
Zinc
American Metal Co.
American Smlg. & Ref. Co.
Am. Zinc, Lead & Smlg. Co.
Grasselli Chemical Co.

Zinc Dust
American Metal Co.
American Smlg. & Ref. Co.
Bartlesville Zinc Co.
Grasselli Chemical Co.
Merrill Co.
U. S. Metals Refining Co.

Zinc Oxide
American Metal Co.
Bartlesville Zinc Co.
Braun Corporation
Braun-Knecht-Heimann Co.
U. S. Metals Refining Co.

Zinc, Sheet
Illinois Zinc Co.
Matthiessen Hegeler Zinc Co.




BUFF
Mining Transits and Levels
It isn't so much what you pay,—it's what you get for the money you pay. Please investigate the past record of the "Buff" and what you get when you buy a "Buff".
Send for Catalogue No. 29
Buff & Buff Mfg. Co., Jamaica Station, Mass.
Chicago, 231 No. Wells St.
46 Dey St., New York

RIBLET AERIAL TRAMWAYS
Automatic, High-Speed; Self-Adjusting Positive Grip
Tell us in detail what you wish to accomplish
Riblet Tramway Co., Spokane, Wash.

SWEAR OFF
Instead of spending the new year swearing about your haulage troubles.
Look us up. It won't cost you anything to talk.
AUTOMATIC AERIAL TRAMWAY
INTERSTATE EQUIPMENT CORPORATION
25 Church St., New York City

Complete Filter Press Equipment

We design and make FILTER PRESSES for all purposes. We also make PUMPS and STRAINERS especially designed for filter press use. We supply especially woven FILTER CLOTH, filter paper, etc.

Our Service Department will study your filtering problem and will, if desired, design and install complete filtering equipment. If **Filtration** plays a part in your manufacturing bring your problem to **Filter Press Headquarters.**

T. SHRIVER & COMPANY
826 Hamilton Street, Harrison, N. J.

SHRIVER
FILTER PRESS HEADQUARTERS

Let Hercules Oil Increase Your Profits

Steam-distilled pine oil is conceded to be the best flotation frother known. Moreover, it is the cheapest flotation reagent in the long run because it recovers the greatest amount of concentrate per ton of ore.

This fact has found favor for Hercules Pine Oil with many flotation operators and engineers.

Hercules Pine Oils are produced under strict chemical control. The grade of oil which best meets your needs having been determined, we can supply that grade in uniform shipments.

We invite correspondence and offer the services of our technical staff in helping you solve your flotation problems.

HERCULES POWDER CO.
Wilmington Delaware

SALES OFFICES:
New York, N. Y. Duluth, Minn.
Chicago, Ill. Joplin, Mo.
San Francisco, Calif. St. Louis, Mo.
Salt Lake City, Utah Chattanooga, Tenn.
Birmingham, Ala.

HERCULES Flotation Oils
Produced Under Chemical Control

Sweetland and Kelly Pressure Filters
•
American Continuous Filters

UNITED AMERICAN SWEETLAND KELLY FILTERS

United Filter Presses
•
Sweetland Patent Metallic Filter Cloth

UNITED FILTERS CORP. HAZLETON PA.

SOUTHWESTERN EQUIPMENT
for Ore Treatment
K & K Flotation Machines
Southwestern Ore and Oil Feeders
Cottrell Screens and Tables, etc.
SOUTHWESTERN ENGINEERING CO.
1221 Hollingsworth Bldg., Los Angeles, Calif.

Specify **OLIVER** For economy in your filtering operation. *Write for information*

OLIVER CONTINUOUS FILTER CO.
San Francisco 501 Market St. New York 33 W. 42d St. London 11 Southampton Row

FILTER BAGS SPECIAL CLOTH FILTER COVERS
FLOTATION POROUS BOTTOMS
The Filter Fabrics Co.
Felt Bldg Salt Lake City Utah

BERGER
Monitor Transits and Levels
C. L. BERGER & SONS, Inc.,
BOSTON, 20, MASS., U. S. A.
Agents for the States of New York and New Jersey
New York Blue Print Paper Co.
102 Reade St., New York City.

FLOTATION OILS
No. 5 PINE OIL The Long Established Standard Pine Oil
Effective Oils of Each Class
PINE—HARDWOOD—COAL TAR OILS
General Naval Stores Co., 90 West St., New York

AINSWORTH
PRECISION BALANCES AND SURVEYING INSTRUMENTS
W. & L. E. GURLEY & SONS THE PRECISION FACTORY DENVER, COLO. U. S. A.
Send for Descriptive Literature
Bulletin A-8 of Balances and Weights
Catalog B-8 of Surveying Instruments
Bulletin C-8 of Improved Brunton Transit

ALPHABETICAL INDEX TO ADVERTISEMENTS

	Page
Abendroth & Root Mfg. Co.	46
Ainsworth & Sons, Wm.	53
Alberger Pump & Condenser Co.	34
Allis-Chalmers Mfg. Co.	8
American Blower Co.	49
Amer. Continuous Filter Co. (See United Filters Corp.)	53
American Metal Co., Ltd., The	38
American Smelting & Refining Co.	41
American Spiral Pipe Works	34
American Steel & Wire Co.	52
American Zinc, Lead & Smelting Co.	40
Atlas Car & Mfg. Co., The	28
Austin Mfg. Co.	38
Baker & Co., Inc.	39
Balbach Smelting & Refining Co.	40
Bartlesville Zinc Co.	40
Berger & Sons, C. L.	53
Bethlehem Foundry & Machine Co.	26
Braun Corporation, The	49
Braun-Knecht-Heimann-Co.	49
Brown Hoisting Mchy. Co., The	30
Buchanan Co., Inc., C. G.	21
Bucyrus Co.	31
Buff & Buff Mfg. Co.	52
Bury Compressor Co.	32
Car Dumper & Equipment Co.	47
Cement-Gun Co., Inc.	49
Chicago Perforating Co.	26
Chicago Pneumatic Tool Co.	13
Chisholm-Moore Mfg. Co., The	36
Cleveland Rock Drill Co., The	51
Cochise Rock Drill Mfg. Co.	51
Colonial Steel Co.	Fourth Cover
Colorado Iron Works Co.	30
Connersville Blower Co.	49
Crandall Packing Co.	34
Deister Concentrator Co., The	30
Deister Machine Co.	30
Denver Fire Clay Co., The	49
Denver Rock Drill Mfg. Co., The	5
Dewar Mfg. Co.	37
Diamond Drill Carbon Co., The	54
Dings Magnetic Separator Co.	Third Cover
Dorr Co., The	46
Dwight & Lloyd Sintering Co., The	51
Falk Corporation, The	37
Fate-Root-Heath Co., The	28
Fawcus Machine Co.	36
Filter Fabrics Co., The	53
Flory Mfg. Co., S.	36
General Naval Stores Co.	53
Goodman Mfg. Co.	29
Grasselli Chemical Co., The	38
Greenawalt Sintering Apparatus and Process	47
Greene, Tweed & Co.	35
Grier Bros. Co., The	37
Gurley, W. & L. E.	53
Harbison - Walker Refractories Co.	34
Hardsocg Wonder Drill Co.	51
Hardy & Ruperti, Inc., Chas.	40
Harrington & King Perforating Co.	49
Harron, Rickard & McCone	46
Hendrick Mfg. Co.	26
Hercules Powder Co.	53
Hoar Shovel Co., Inc., The	31
Illinois Zinc Co.	40
Ingersoll-Rand Co.	11
International Nickel Co., The	38
International Smelting Co.	39
Interstate Equipment Corp.	52
Irvington Smelting & Refining Works	40
James Ore Concentrator Co.	38
Jeffrey Mfg. Co., The	4
Justrite Mfg. Co.	37
Kelley Filter Press Co. (See United Filters Corp.)	53
Krogh Pump & Mchy. Co., The	32
Lake Superior Loader Co.	30
Leschen & Sons Rope Co., A.	52
Link-Belt Co.	23
Little Giant Co.	34
Ludlow-Saylor Wire Co., The	6
Lunkenheimer Co., The	36
Marion Steam Shovel Co., The	18
Matthiessen & Hegeler Zinc Co.	39
McGraw-Hill Book Co., Inc.	33
Merrill Co., The	34
Midvale Co., The	19
Mine & Smelter Supply Co., The	30
Morris Machine Works	32
Mundy Hoisting Engine Co., J. S.	37
National Tank & Pipe Co.	46
New York Engineering Co.	31
Nichols Copper Co.	39
Niles-Bement-Pond Co.	36
Nordberg Mfg. Co.	32
Nuttall Co., R. D.	35
Ohio Brass Company, The	54
Oliver Continuous Filter Co.	53
Ottumwa Iron Works	47
Pelton Water Wheel Co., The	32
Phelps-Dodge Corporation	38
Powell Co., The Wm.	34
Prescott Co., The	14
Prest-O-Lite Co., Inc., The	22
Professional Directory	42
Riblet Tramway Co.	52
Robins Conveying Belt Co.	54
Roebling's Sons Co., John A.	49
Rogers, Brown & Co.	38
Roots Co., The P. H. & F. M.	49
Searchlight Section	24-25
Shriver & Co., T.	53
Smith Engineering Works	10
Southwestern Engineering Co.	53
Standard Diamond Drill Co.	51
Stearns-Roger Mfg. Co., The	15
Stephens-Adamson Mfg. Co.	Second Cover
Sturtevant Co., B. F.	26
Sullivan Machinery Co.	7, 51
Sweetland Filter Press Co., (See United Filters Corp.)	53
Taylor-Wharton Iron & Steel Co.	16
Traylor Engineering & Mfg. Co.	12
Tyler Co., The W. S.	26
Union Construction Co.	30
United Filters Corp.	53
United Metals Selling Co.	39
United States Metals Refining Co.	38
United States Smelting, Refining & Mining Co.	41
Vulcan Iron Works	17
Watt Mining Car Wheel Co., The	28
Webster Mfg. Co., The	20
West Virginia Rail Co., The	47
Westco-Chippewa Pump Co.	32
Western Wheeled Scraper Co.	28
What and Where to Buy	48
Whitcomb Co., Geo. D.	28
Wile Electric Furnace & Engineering Co.	27
Wilfley & Sons, A. R.	9
Yuba Mfg. Co.	30

INDEX TO SEARCHLIGHT SECTION

American Tripoli Co.	25
Farrell, J. H.	24
Marshall, Wm. A.	24
Morse Bros. Machy. & Supply Co.	25
Olds, H. A.	25
Phelps' Occupational Bureaus, Inc.	24
Rosenburg & Co.	25
Royal Tiger Mines Co.	25
Scott, George S.	24
Thyle Machinery Co.	25
United Verde Extension Mining Co.	25

Trolley Supplies, Rail Bonds

Porcelain Insulators

The Ohio Brass Company

MANSFIELD, OHIO

ROBINS CONVEYING MACHINERY

For every material handling need

We design, manufacture and erect BELT CONVEYORS, BUCKET ELEVATORS, SKIP HOISTS, COAL AND COKE CRUSHERS, "PERFEX" SCREENS, and many other types of material handling BRIDGES, and many other types of material handling equipment.

Write for Hand-Book of Conveyor Practice

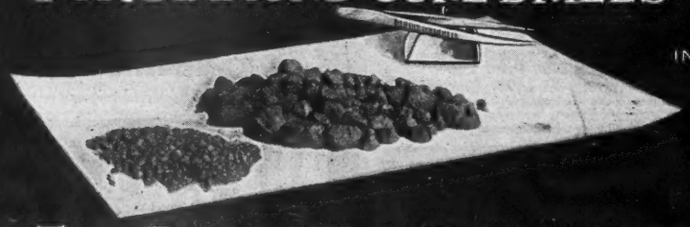
ROBINS CONVEYING BELT COMPANY

New York, 15 Park Row **Chicago, Old Colony Bldg.**

Boston, 7 Water St. **Pittsburgh, Union Trust Bldg.**

CARBON (BLACK DIAMONDS)

FOR DIAMOND CORE DRILLS



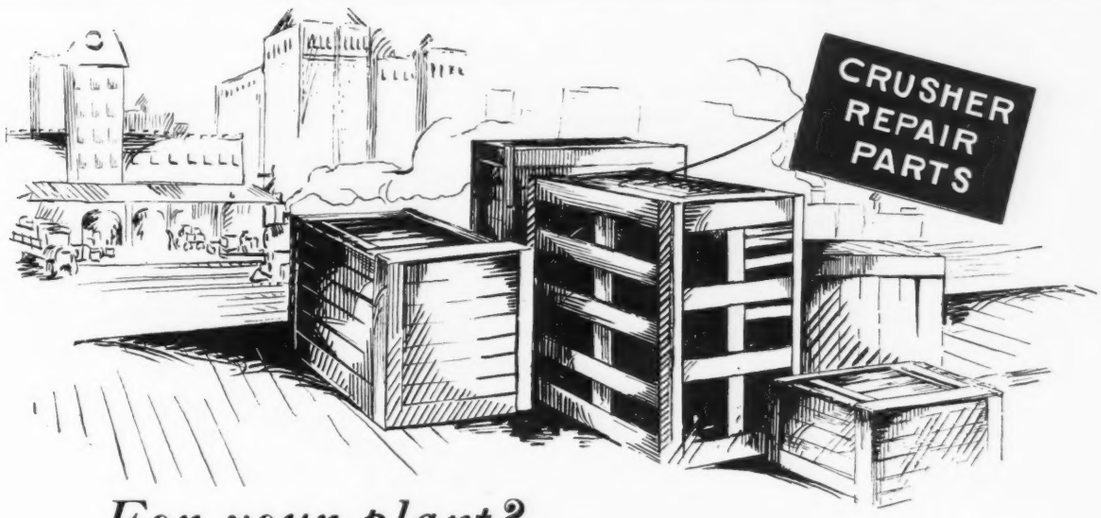
-IMPORTERS-
INDUSTRIAL DIAMONDS

-MANUFACTURERS-
DIAMOND POINTED TOOLS FOR ALL MECHANICAL PURPOSES

OUR TESTED CARBON WILL KEEP YOU OUT OF DIFFICULTY WRITE OR WIRE FOR PARTICULARS

THE DIAMOND DRILL CARBON CO.

67 PARK ROW, NEW YORK, N.Y. CABLE ADDRESS-CREDOTAN, N.Y.



For your plant?
The Dings ends these shipments...

A shipment of crusher repair parts means trouble. It tells a story of wrecked crushers . . . interrupted production . . . idle men . . . repair bills . . . lowered morale . . . loss of money.

End these shipments! The Dings "High Intensity" Magnetic Pulley does it. It removes the tramp iron from the ore before it can enter the crusher. Production goes on uninterrupted.

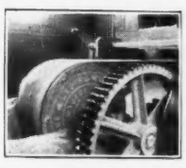
The bulletin tells how the Dings ends the tramp iron menace. Shall we send you a copy? Do you want, also, the bulletin that tells how other types give high recoveries in refining? Just check the post card—

Dings Magnetic Separator Co., 673 Smith St., Milwaukee

NEW YORK
52 Vanderbilt Ave.
PITTSBURGH
1522 Oliver Bldg.
CHICAGO
115 S. Dearborn St.
CLEVELAND
Leader-News Bldg.
DENVER
1718 California St.
ST. LOUIS
F'd'l Reserve Bank Bldg.
DETROIT
Hammond Bldg.
EL PASO, TEXAS
1st Nat'l Bank Bldg.
LOS ANGELES
San Fernando Bldg.
SALT LAKE CITY
201 Dooly Block
CINCINNATI
Mercantile Library Bldg.
SAN FRANCISCO
419 Call Bldg.
SANTIAGO DE CHILE
S. A. Bandera 261
JOHANNESBURG
SOUTH AFRICA
The Corner House
MELBOURNE
AUSTRALIA
Broken Hill Chambers, 31 Queen St.
KRISTIANIA
NORWAY
520 Commerce Bldg
MADRID, SPAIN
Conde de Aranda 11
LONDON, ENG.
728 Salisbury House

Dings *High Intensity*
MAGNETIC SEPARATION

Dings Mag. Sep. Co.,
673 Smith St., Milwaukee.
Send me ☐ Magnetic pulley bulletin.
☐ Refining bulletin.
Firm .....
Address .....
.....
Attention .....
E.&M.J.-P. 12-29-23

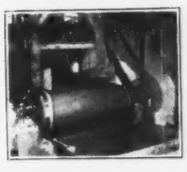


This Dings Pulley was installed in the plant of the Golden Cycle Mining Co., Colorado Springs, Colorado, in 1916. There's no crusher wreckage here!

Laboratory Service:

TO determine the possibilities of magnetic separation, a large laboratory is maintained. Here, at nominal cost, samples of ores are analyzed. Ask for directions for sending a sample.

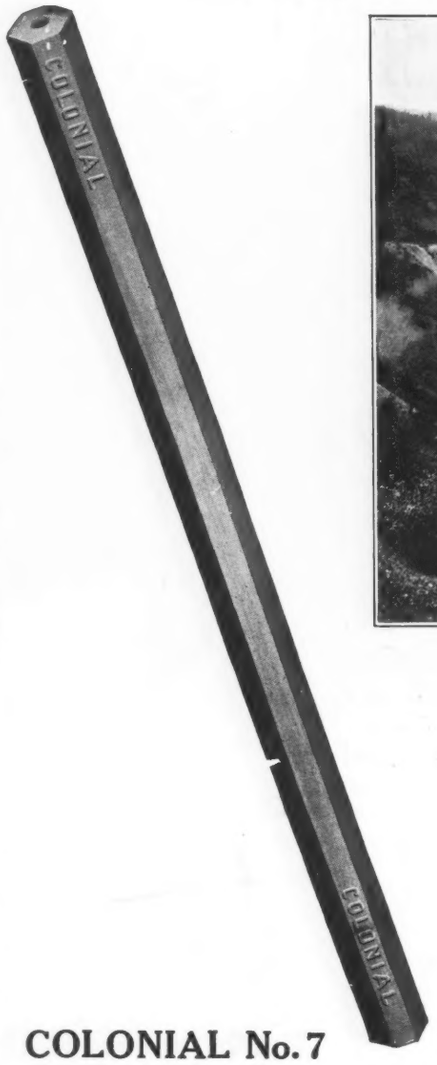
A Dings Pulley on guard. It's on the job stopping bolts, nuts, muleshoes and other iron that might enter the crusher.



VANADIUM

RED STAR

DRILL STEEL



COLONIAL No. 7

A Vanadium Tool Steel

Used in dies, dollies, tappets, pistons and hammers it has doubled the service. Vanadium adds durability. Colonial No. 7 is a Vanadium Steel produced in a mill that makes only fine Tool Steels.

Judge Mine of Park City Mining Company

All Now Standardized on "Red Star Vanadium"

"BE NOT the first, nor yet the last, to adopt that which is new." This sound advice which has come down through the years from Benjamin Franklin, is practical today in selecting Drill Steel.

After first conclusively proving out Red Star Vanadium through repeated local shipments to their various mines, the Park City Mining Company have secured a carload from the Colonial Mill. All of their properties are now standardized on this master Drill Steel.

Vanadium makes steel tougher, denser, more resistant to breakage. Red Star Vanadium holds its edge and its gauge longer, cuts faster, materially reduces drill bit breakage. Use it to increase footage, use it for the saving it makes. Red Star Vanadium pays you both ways.

In stock at Colonial warehouses to immediately take care of your needs. Its continued satisfaction will demonstrate the advantages of standardizing all your mines on Red Star Vanadium

Colonial Steel Company

PITTSBURGH NEW YORK CHICAGO BIRMINGHAM ST. LOUIS
DENVER SALT LAKE CITY WALLACE PHOENIX EDW. L. SOULÉ CO., SAN FRANCISCO